Aviation Week and Space Technology

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December 11, 1961

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Sikorsky's S-61L, HSS-2, S-62

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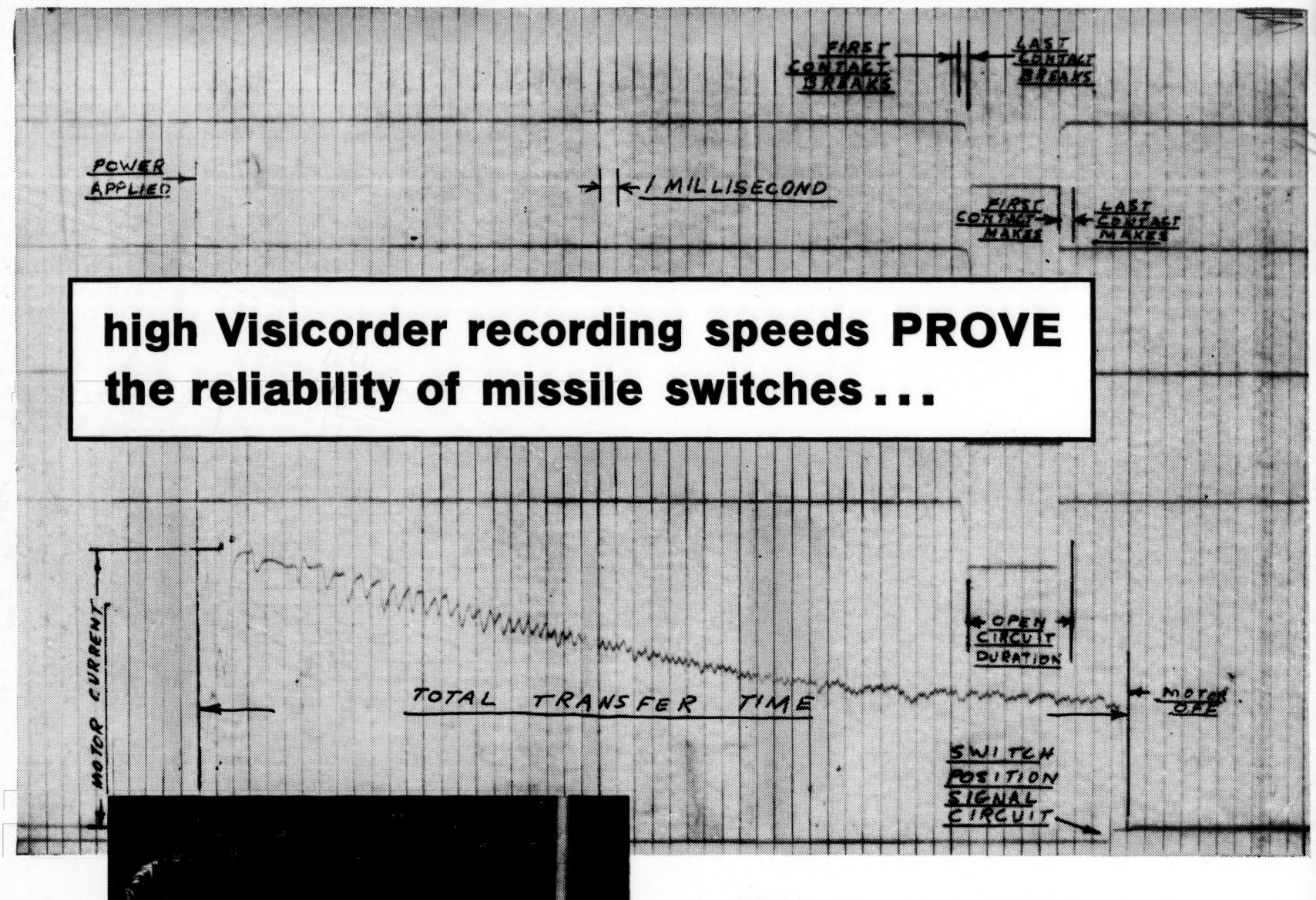

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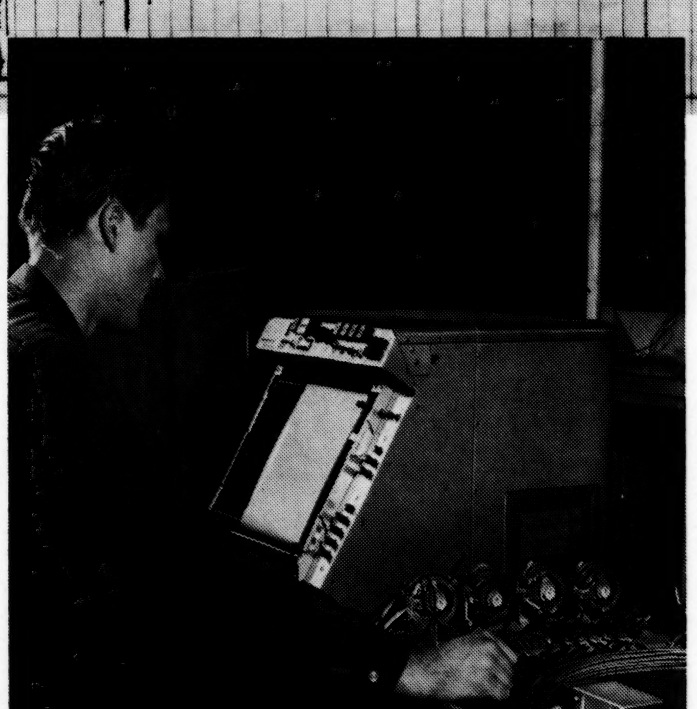

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AEROSPACE CALENDAR

Dec. 12-14—Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.

Dec. 18—25th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Jan. 8-12—1962 Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit.

Jan. 9-11—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 15-17—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

Jan. 16-18—Eighth Annual National Meeting, American Astronautical Society, Sheraton-Park Hotel, Washington, D. C.

Jan. 21-24—Annual Meeting, Helicopter Assn. of America, Marriott Motor Hotel, Dallas, Tex.

Jan. 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

Jan. 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

Jan. 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

(*Continued on page 6*)

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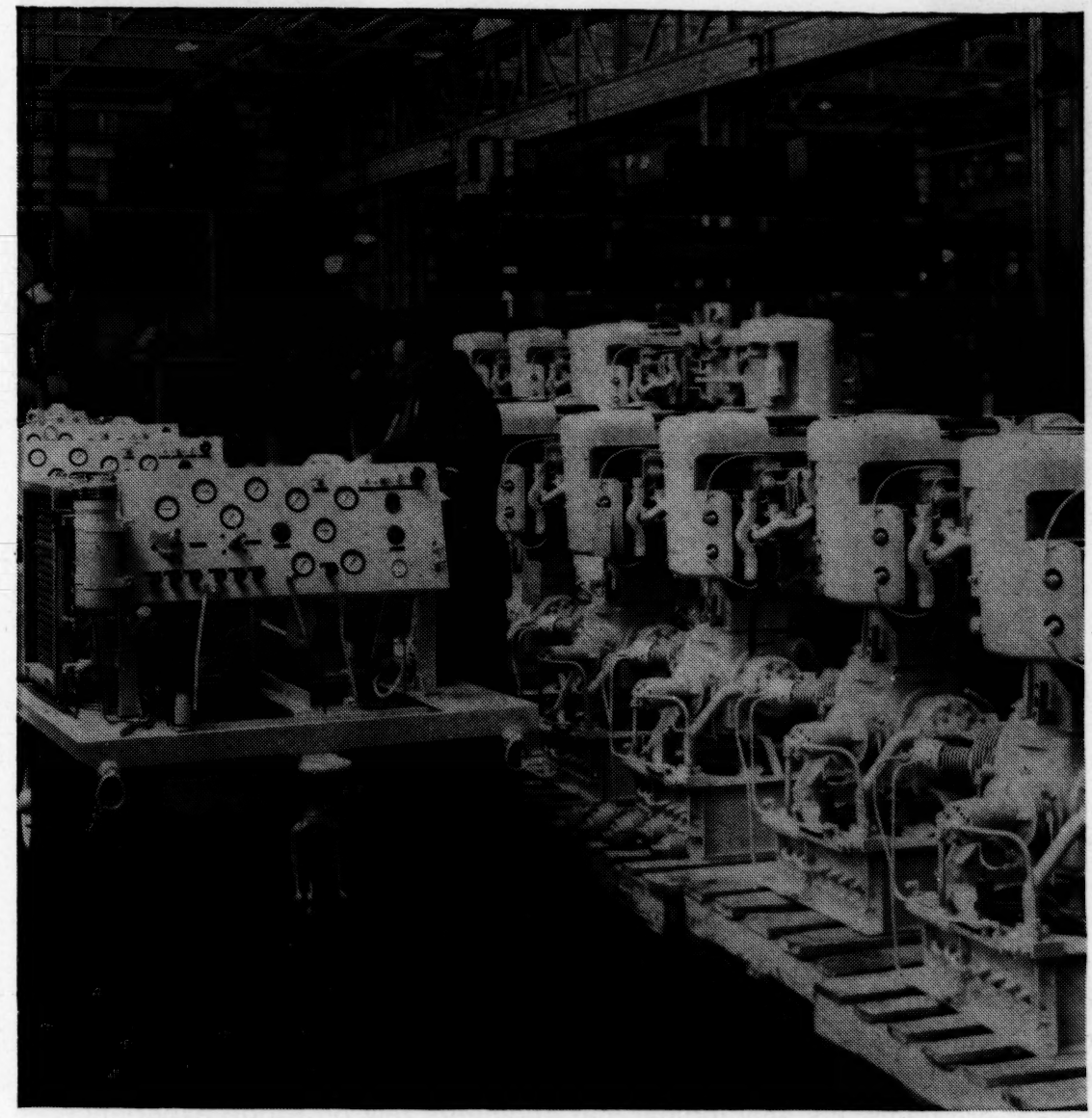

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AEROSPACE CALENDAR

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Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 19-21—Range Reconnaissance and Tracking of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section-Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences' Flight Propulsion Meeting (classified), Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

Mar. 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

Apr. 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Re-entry Communication and Detection, New England Mutual Hall, Boston, Mass. Sponsor: AF Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show, Institute of Radio Engineers, Rice Hotel, Houston, Tex.

Apr. 16-18—Second International Flight Test Instrumentation Symposium, College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Meeting, Institute of the Aerospace Sciences, Salt Lake City, Utah.

December 11, 1961

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COVER: Sikorsky Aircraft Division of United Aircraft Corp.'s turbine-driven helicopters are shown at Stratford, Conn. Bottom aircraft, in Los Angeles Airways' markings, is the S-61L. The aircraft was recently turned over to LAA. Middle aircraft, in Navy markings, is the HSS-2 and is part of the ASW production line. Top helicopter is the S-62 and is being utilized as a United Aircraft executive transport. The helicopters are powered by General Electric T58 powerplants.

PICTURE CREDITS

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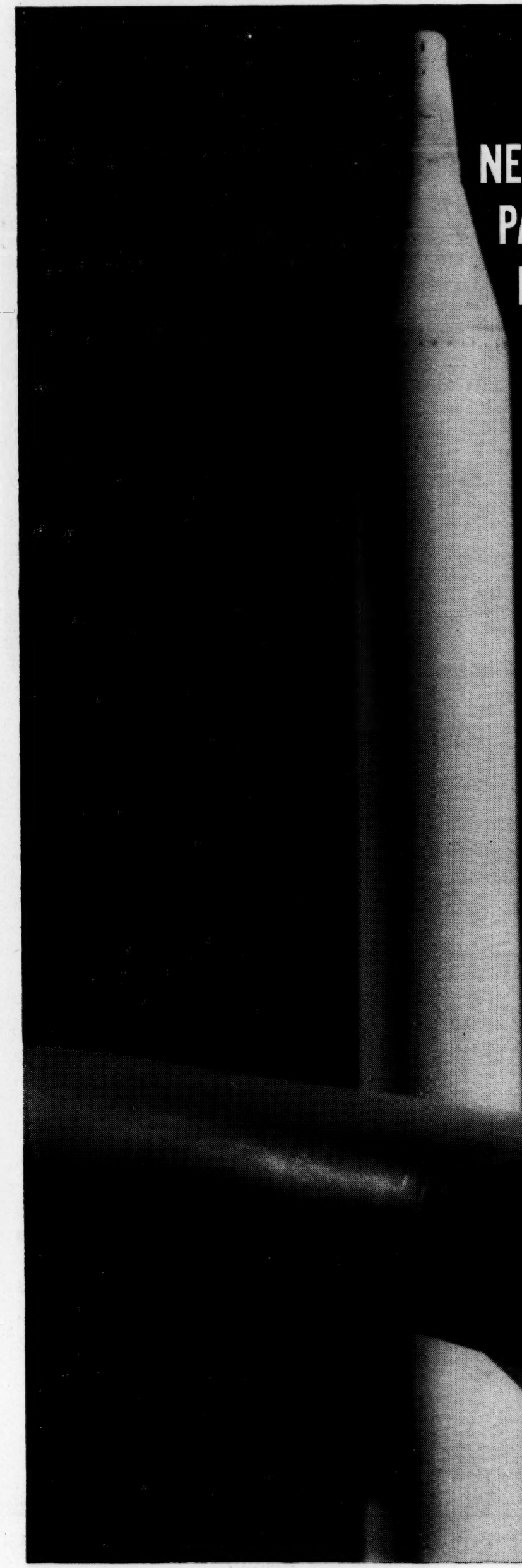

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EDITORIAL

The Prospect Ahead

The aerospace industry can look forward to an improving market next year with space technology as its most expansive segment. The defense budget of about $51 billion will place heavy emphasis on missiles, aircraft and space technology despite an increase in foot-soldiers' equipment and "iron bomb" capability. National Aeronautics and Space Administration, with a proposed Fiscal 1963 budget close to $3.5 billion, will offer a space technology market that not even the wildest space cadet would have dared to predict a few years ago.

The trend of the new programs in both the Defense Department and NASA budgets clearly indicates that the aerospace industry is facing another period of tremendous technical change as its always galloping technologies are spurred to further acceleration by Soviet competition and a U.S. leadership that is no longer interested in settling for second best. The next year, and those beyond it, will place unprecedented demands on both the technology and the management of the aerospace industry to accomplish the national goals within the fiscal resources available.

Even though the size of the aerospace market will grow substantially during the next few years, there is no assured prospect of success for any individual company simply riding along on the growth wave. The unique technical demands of this aerospace market will raise hurdles that not every organization will be able to jump successfully. We predict that the rewards to the technically alert and competent organizations which stay a jump or two ahead of the field, and the lean, fast moving management structures that are responsive to these quickly changing technical demands, will be substantial. However those organizations whose management philosophy is simply to float with the tide and rely solely on their political liaisons may be due for some rude surprises.

Uneasy Interlude

In the face of this generally rosy-hued horizon for 1962, however, there are some thunderheads developing that could produce some violent searing interludes. One of these thunderheads has been a growing volume of criticism aimed at labeling the aerospace industry as one of the sinister threats to the American way of life. Coming mostly from the left wing of American politics, but eagerly abetted by some high Pentagon civilians, this barrage is intended to paint the aerospace industry as a partner with the military in a carefully organized conspiracy aimed at keeping the struggle with the Soviet Union close to the boiling point to insure full and profitable employment in both industry and the upper levels of the military.

Unfortunately some elements of both industry and the military have behaved in a manner to lend credence to this basically false picture. The few sensational, and thoroughly reprehensible industry-military incidents spotlighted by the Hebert congressional hearings are taken by an unsuspecting public as the rule rather than the exception. The extreme right wing political activity of a number of high ranking generals and admirals, most of whom are still drawing taxpayers' dollars in retirement pay, certainly can be cited as evidence of a military bent to substitute its disciplines for democracy. This activity also makes it difficult for the large majority of conscientious officers in uniform to do their jobs properly.

AIA Warning

Neither the aerospace industry nor the military have exhibited much sense in their blatant exhibitions of how they can squander the taxpayers' dollars in public saturnalia designed to make a pitch for individual services. The Aerospace Industries Assn. has shown a rare touch of statesmanship in recently warning its members to drastically reduce their participation in these events. The major technical societies also are considering this problem and, hopefully, will alter their policies to reduce the number of technical meetings and exhibits to a significant minimum. It still remains, however, for the military itself to take the pressure off the aerospace industry to participate in these excessive events that serve no useful purpose except for professional promoters.

The majority of the aerospace industry would not participate in these affairs if the military did not apply direct and blunt pressure on companies to do so. Continuation of these activities cannot help but to serve the purpose of those who are bent on depicting the military-industry relationship as an unholy alliance inimical to the best interest of this country.

Both the conscientious elements in the military and the aerospace industry face a serious problem in combating this attack from the left wing combined with the boring from within emanating in the outer rings of the Pentagon. For the success of any such campaign of vilification of the aerospace industry and the military profession, as is now in full swing, can only result in a weakening of our national strength and an easier task for the enemies of our system of government.

—Robert Hotz

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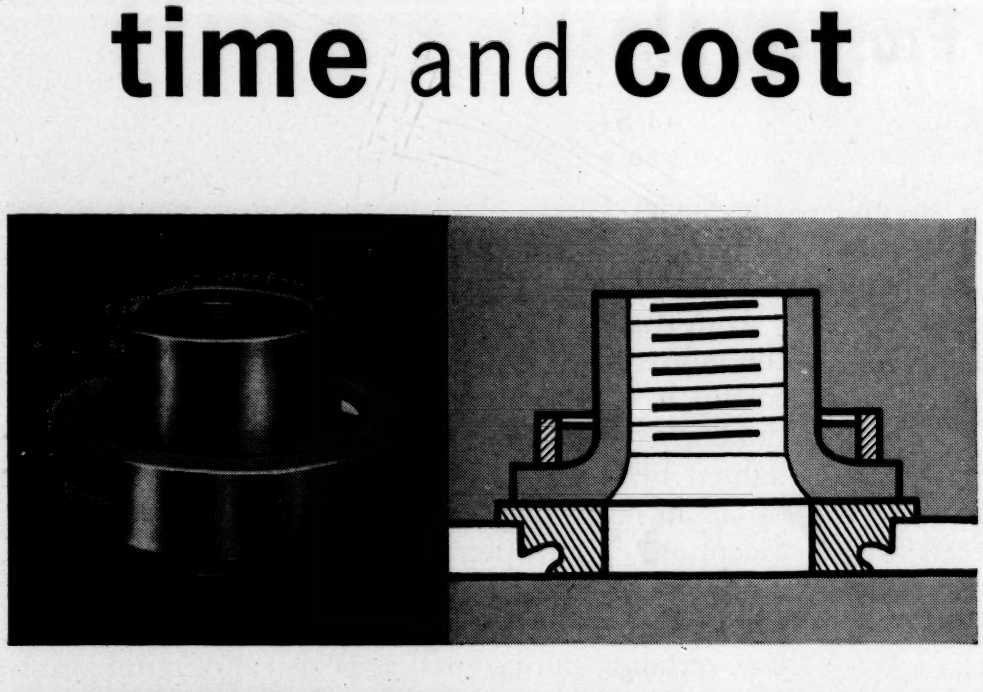

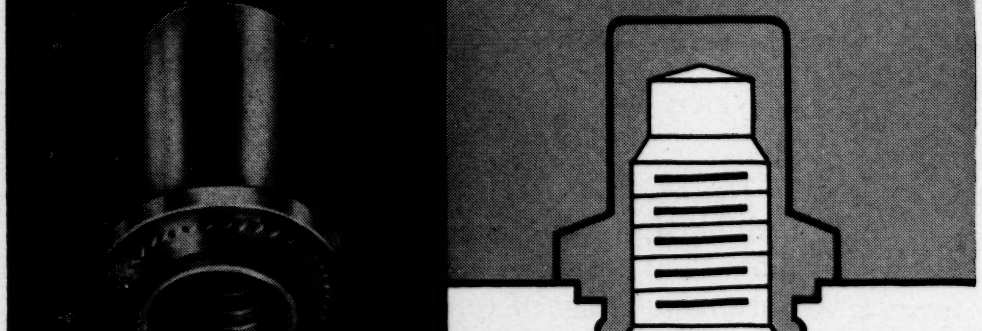

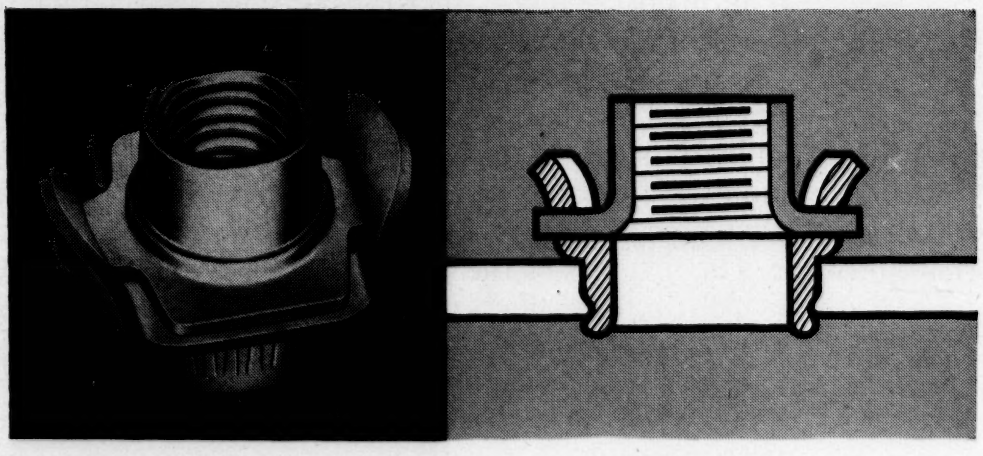

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The Franklin Institute, Philadelphia, Pa., has named **Francis L. Jackson** the director of its Laboratories for Research and Development and an officer of the Institute, succeeding **Dr. Nicol H. Smith**, retired.

Honors and Elections

John Mihalic, a vice president of Avco Corp. and president of the company's Nashville (Tenn.) Division and the Electronics and Ordnance Division (Cincinnati), has been named Management Man of the Year by the National Management Assn.

George F. Metcalf, General Electric Co.'s regional vice president for Washington Defense Activities, has been elected 1962 chairman of the Guided Missile Council of the Aerospace Industries Assn. AIA also has announced the election of **James B. Gordon**, secretary and general counsel of The Bendix Corp., as 1962 chairman of the Procurement and Finance Committee, and **Joseph Corie**, Northrop Corp.'s comptroller and **Edward Curtis**, Douglas Aircraft Co.'s director of contracts, as vice chairmen; **Walter J. Jason**, patent director of General Dynamics/Convair, as 1962 chairman of the Patent Committee, and **Charles Hutchins**, patent counsel for General Electric Co.'s Defense Electronics Division, as vice chairman; **Ronald H. Lambka**, supervisor of publications service for the Aerospace Division of Bendix Products, as 1962 chairman of the Service Publications Committee, and **Arthur J. Davidson**, chief of service publications for the Aerospace Division of The Boeing Co., as vice chairman.

(*Continued on page 118*)

INDUSTRY OBSERVER

► USAF's Air Proving Ground Center is seeking research and development sources with capability for developing new types of warheads for use against ballistic missiles. The center also is seeking sources to conduct studies of impact effects on special fragments at velocities above 12,000 fps. Both efforts apparently are in support of Advanced Research Projects Agency's Project Defender anti-ICBM program.

► **Dassault's entry in the NATO competition for a V/STOL transport is a 70,000-lb. high-wing aircraft with a maximum speed of 400 kt. It would utilize Rolls-Royce RB.162s for STOL takeoff within 300 ft. over a standard obstacle. Forward propulsion would be achieved by wing-mounted Pratt & Whitney JTF-10s.**

► Mercury Mark 2 capsule, which will be used for two-man flights of up to 14 days, now has a design with a base diameter of 83 in. Recovery weight would be 5,500 to 6,000 lb. Recovery would be accomplished with a 96-ft. parachute, a cluster of smaller chutes or a glide-sail chute.

► **First flight of the Bristol T.188 stainless steel supersonic research aircraft (AW Nov. 13, p. 23) will be delayed several weeks. The company attributes the delay to minor snags. Flight will be from Filton to the Ministry of Aviation facility at Boscombe Down, which has longer runways.**

► Request for proposals for a study of a temporary lunar shelter or base suitable for use by military personnel was issued last week by USAF's Aeronautical Systems Division. They are due by Dec. 28. Study probably will be no larger than a companion study of a manned lunar roving vehicle (AW Nov. 13, p. 23). It will originate from the support techniques branch of the Flight Accessories Laboratory.

► **Naval Ordnance Laboratory and M. Rosenblatt and Sons, Inc., have designed a 350-ft.-long, 16-ft.-dia. unmanned Seagoing Platform for Acoustics Research (SPAR). It would be used in the Atlantic and would measure speed and intensity of underwater sound at depths to 300 ft., relaying data to a tending towship by electrical cable. Office of Naval Research and Marine Physical Laboratory of Scripps Institute of Oceanography have designed a similar device called Floating Instrument Platform (FLIP) for use in the Pacific. It would be manned and allowed to drift with wind and currents. Both are financed by Bureau of Weapons through NOL.**

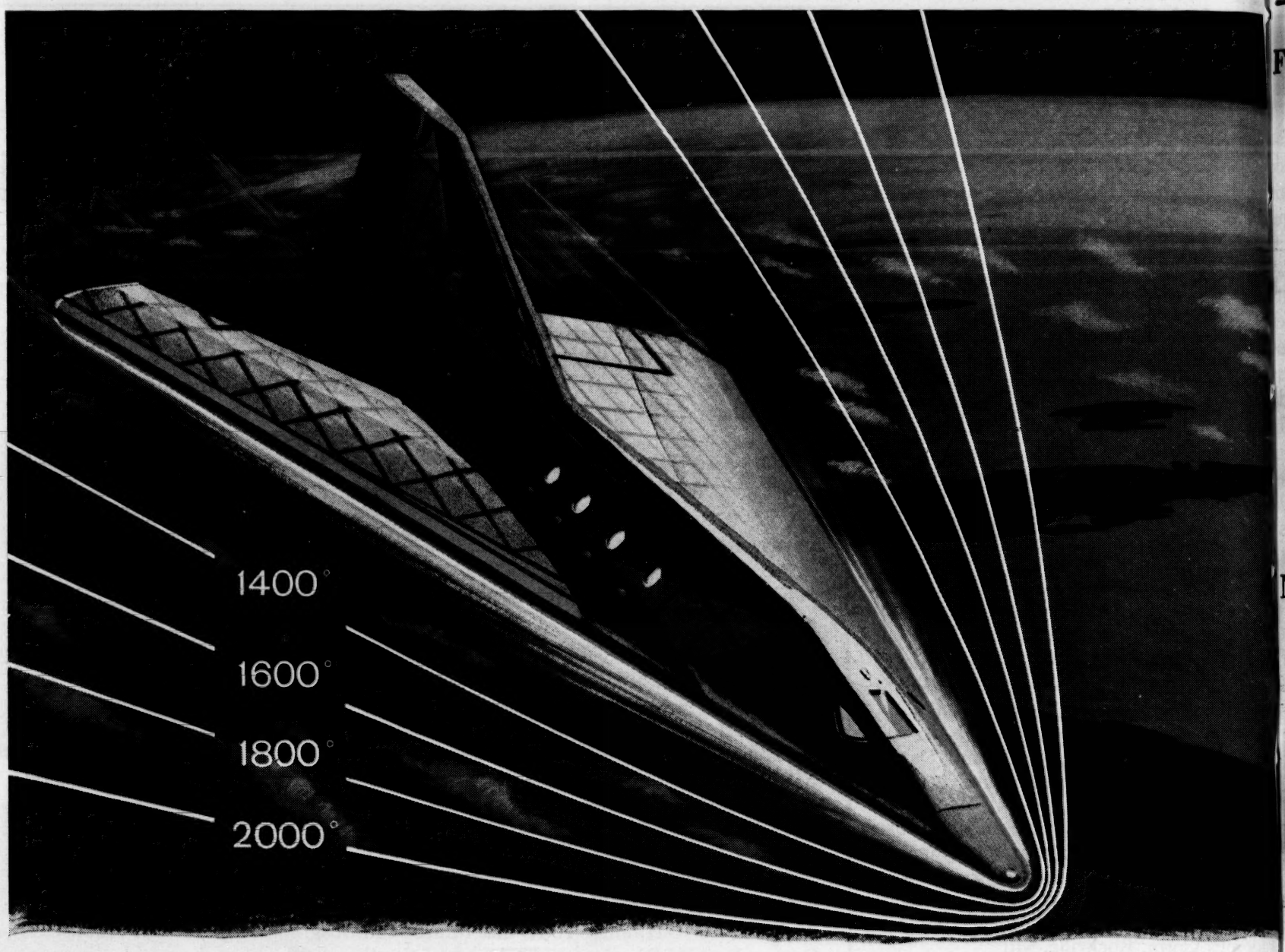
► Swiss government has purchased an evaluation quantity of Beech KDB-1 target drones. Contracts for targets and support systems total about $500,000. Indications are that this sale, which is the first in Europe, precedes a larger Swiss order. West German government also is considering possible purchase of KDB-1s.

► **Army Aviation Board has given top priority to the problem of refueling helicopters and fixed-wing aircraft rapidly in tactical situations. Top officers were scheduled to meet last week to draft requirements for a mobile system, preferably a standard one, that would refuel helicopters at many times the rate achieved now with gasoline trucks.**

► Army expects to ask soon for proposals for studies on the feasibility of making aircraft less detectable by surveillance radar through application of radar echo absorbing material or other techniques.

► **U. S. and Germany have completed negotiations for location of a Relay active communications satellite station in Weilheim, near Munich. German post office will manage construction, which is due to be completed late next year in time for launching of the second Relay.**

► Avco's Lycoming Division expects its T53-L-7 turboprop engine, an advanced version of the T53-L-3 used to power the Grumman AO-1 Mohawk, will develop 1,150 shp. on takeoff and pass production qualification tests next year. Infrared surveillance equipment installed on later series Mohawks resulted in Army's need for a more powerful engine. The T53-L-3 is rated at 960 shp.



Atmospheric Skin Diver... 1980 Style

Double-walled honeycomb panels of HAYNES alloy No. 25 may form the "skin" of a rocket-propelled space glider, predicts a major aircraft company. Already successfully tested, these panels are designed to withstand the terrific temperatures generated as the glider dives back into the earth's atmosphere.

To safeguard the plane's 30 passengers and crew from this blazing re-entry heat, its whole skin, except for leading edges and tail surfaces, will be made of the HAYNES alloy No. 25 panels. Beneath these, a layer of thermal insulation. And liquid circulating through inner walls and airframe will lose excess heat to water to be expended as steam.

Research indicates that a "skin" of this basic type is highly practical. And it seems certain that many other tough, heat- and erosion-resistant HAYNES alloys—some already proved at 2,000 deg. F. and above—will also be aboard.

Whether investment- or sand-cast, rolled, wrought, vacuum melted or air melted, there's a HAYNES high-temperature alloy to meet your needs.

Engineers discuss double-wall test section of space-plane skin with a honeycomb surface panel made of HAYNES alloy No. 25, designed to withstand intense heat of re-entry.

Address inquiries to Haynes Stellite Company, 270 Park Avenue, New York 17, N. Y.

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Washington Roundup

Final Golovin Report

The Golovin Committee made its final report on large launch vehicles to Defense Secretary Robert McNamara on Dec. 4 and National Aeronautics and Space Administration Chief James Webb on Dec. 5, after staying in session several days longer than planned in order to agree on the configuration of the Titan 3. Martin Marietta, Titan's builder, talked to the committee for a day and a half. The conclusion is that Titan 3 should be a Titan 2 with two 120-in. solid motors strapped to the sides. (See p. 26.) This is the vehicle NASA wants for the Mercury Mark 2 flights.

All the Golovin recommendations hinge on the Fiscal 1963 budget and NASA and Defense have agreed on "fall-back stands"—alternative programs in case not all the money requested is approved. Consensus was that both agencies should hold out for the Saturn C-4. Both agencies also want the Nova, but the C-4 and the rendezvous method for reaching the moon are the primary concern.

Source selection board will brief NASA Administrator Webb, Dec. 14, on the competition to build the Saturn S-1B booster. This will be the last of the series of three major contracts to be awarded this year. Others were the Saturn S-1 and Apollo.

Meanwhile, work on the Saturn S-2 stage by North American Aviation is awaiting precise definition of the C-4 vehicle. Crucial point is the diameter of the booster. The S-2 will be used as the second stage of C-4.

New Comsat Policy

National Aeronautics and Space Council is expected to resolve shortly the interagency differences over how broad the ownership base should be in a commercial communications satellite system. A recommendation already submitted to President Kennedy is expected to open ownership to other interests than the communications common carriers. Federal Communication Commission's ad hoc committee had recommended limiting it to the carriers. The council's plan probably will require new legislation and recommend provisions intended to discourage small private investors with get-rich-quick ideas.

Draft report of a study of the extent to which scientists are leaving the government, and why scientists prefer to stay or leave, is being circulated among interested agencies for comment. It was conducted by Dr. Allen V. Astin, director of the National Bureau of Standards.

Budget Bureau's report on government contracting procedures with non-profit corporations and their impact on the government's ability to attract and hold scientists (AW Dec. 4, p. 31), now is not expected to be ready until early February. President Kennedy had asked that it be ready by Dec. 1.

Switch for Hayward

Vice Adm. John T. Hayward, deputy chief of naval operations for development, has been granted his request for the rear admiral's sea command that he skipped when he was promoted into his present job. He will become commander of an attack carrier division next March, probably in the Atlantic, and drop to the lower rank. Precedent for such a move was set by Adm. George W. Anderson, now chief of naval operations, who left the vice admiral's job of deputy commander-in-chief of the Pacific Fleet to take a carrier division. A similar decision is faced by Vice Adm. William F. Raborn, head of the Polaris project, who was promoted in his present position.

Defense Department soon will solicit industry comment on proposed new procurement regulations designed to broaden the use of incentive contracts (AW Nov. 20, p. 26). Procurement officials feel industry should have about a month to comment before the rules take effect.

Pace Prediction

Despite denials, watch for Frank Pace, Jr., to leave his post of chairman and chief executive officer of General Dynamics Corp. by next spring. Henry Crown, who became a major General Dynamics stockholder as a result of General Dynamics' merger with Material Service Corp., has been playing a key role in seeking a new chairman since late summer. Crown heads a special executive committee of directors named last August. Earl D. Johnson, General Dynamics president who is now based in San Diego, Calif., may remain with the corporation.

Air Force Missile Development Center and Army Missile Test Center would like to see the U. S. make White Sands Missile Range in New Mexico the National Aerospace Landing Site for recovery of re-entry vehicles. They cite physical advantages and experience with 12,000 drone and missile flights in the past 15 years.

Secretary McNamara has asked the services for so many one- and two-page comments on the changes he has made in their budget requests that the reports are being called "snowflakes." By late last week there were more than 600 of them and McNamara had read them all.

—Washington Staff

New Defense Request to Total $51 Billion

Fiscal 1963 budget breakdown to give $21 billion to USAF, $15 billion to Navy, $13 billion to Army.

By Larry Booda

Washington—Kennedy Administration will ask Congress next month for $51 billion in new obligational authority for the Defense Department in Fiscal 1963. It will be divided this way—Air Force, $21 billion; Navy, $15 billion; Army, $13 billion, and Office of the Secretary of Defense, $2.1 billion. Final decisions on programs were being hammered out late last week.

New obligational authority voted by Congress for Fiscal 1962, after the Kennedy Administration had modified the original Eisenhower requests and Congress had modified the Kennedy requests, was $18.8 billion for Air Force, $14.5 billion for Navy, $11.8 billion for Army and $1.31 billion for the Secretary of Defense (AW Aug. 14, p. 30).

Expenditures for the current fiscal year are expected to reach $47 billion and exceed $50 billion for each of the succeeding five years. It was indicated the Administration had ordered a delay in obligating funds for the increase in forces this calendar year so that the resulting expenditures will be delayed until Fiscal 1963 and not increase the expected Fiscal 1962 deficit.

Highlights of the $51 billion budget request figure, which does not include mutual security, are:

• **Funds for production** of long lead-time items for the Army's Nike Zeus anti-missile missile are included. Recent successful test firings of the missile are believed to have influenced the decision.

• **No increase in funds** for the Strategic Air Command is requested. Almost all the increase in the Air Force budget would go into tactical forces. This includes $500 million for conventional aircraft armament.

• **Medium-range ballistic missile** development funds are included as an Air Force program. Army participation will be encouraged because of its experience in developing heavy vehicles for mobile missiles.

Until this action, use of a growth version of Army's Pershing missile had been urged for the MRBM mission. But the roles and missions assigned by the Defense Department limit the Army's sphere to 100 mi. beyond a front. This would place a range limit of about 200 mi. on the Pershing. The MRBM will go beyond that to where the intermediate range ballistic missiles take over, or about 1,000 mi. It would be more economical than the IRBM and would be far more mobile.

• **New funds for USAF's** Dyna-Soar boost-glider will be less than the $100 million asked for Fiscal 1962. This was still a subject of controversy late last week.

Secretary of Defense Robert S. McNamara said last month that an extra $85.8 million voted by Congress for Dyna-Soar would not be spent, and said he considered the current level of funding to be sufficient. A recent Defense policy directive states: "Technical feasibility shall not be considered as a justification for weapon system or equipment development. Only weapon systems and major equipments which fulfill clearly recognized military needs shall be approved by the Director of Defense Research and Engineering."

• **Ballistic missiles** remain high on the priority list. Sharpest increase is for the USAF Minuteman solid propellant ICBM, which will be funded with $2.1 billion. Navy's Polaris submarine-launched ballistic missile will remain highly funded with $2 billion.

Funds for Titan will drop to about $600 million from the current $1.3 billion. Mobile Minuteman request is for $270 million. Request for the Skybolt air-launched ballistic missile is $325 million.

• **Modest funding** is requested for concepts of manned satellite stations and offensive space systems, but funding for projects such as USAF's Samos reconnaissance satellite and Midas infrared missile detection satellite, Army's ANNA geodetic satellite, and Navy's Transit navigational satellite is substantial. Amount of funds for Army's Advent communications satellite was still in doubt.

• **Funds are asked** for a conventionally powered Navy aircraft carrier. This item is considered a politically sensitive one and could be eliminated during the next session of Congress as a compromise move. Consideration was given to the opinions of many congressmen that such a ship should be nuclear powered if built at all.

• **McDonnell F4H jet fighter** is in-

120-in. Rocket Proposal Requests Imminent

Issuance of requests for proposals by Air Force to solid-propellant motor manufacturers for development of the 120-in.-dia. rocket, now known as Program 624, is not expected to be delayed beyond this week. Probably not more than one month will be allowed for submission of proposals.

Altering previous plans, Air Force now intends to:

• Award a single contract instead of supporting dual, parallel efforts.

• Develop the 120-in.-dia. solid-propellant motors within the framework of the Titan 3 project (Titan 2 with two 120-in. units attached to the base of the first stage) instead of designating the motors as government-furnished equipment. Prime reason behind this is that Air Force probably feels that this specific requirement would commit the development more firmly. Another reason is that, minus the critical areas which are to be investigated under applied research contracts from Edwards AFB, it is felt that one contractor could efficiently handle development of the 120-in.-dia. motor.

Negotiations for this applied research (AW Nov. 27, p. 25) already have been completed by United Technology Corp., Aerojet-General and Lockheed Propulsion Co. with the 6593rd Test Group (development) at Edwards AFB, under Air Force Systems Command's Space Systems Division. Each of these contracts will be for approximately $2 million and will furnish critical data on nozzle material and fabrication, thrust vector control by fluid injection, and ignition, in support of the basic Air Force development contract for the 120-in.-dia. motor.

These applied research contracts are, in effect, parallel efforts similar to Air Force practice initially used for Minuteman ICBM motor development, and will be funded by Edwards from a $13.6-million allotment. Some of the remaining funds probably will be used to cover additional research expected to stretch the state of the art in the same critical areas—nozzles, thrust vector control and ignition.

Conjecture is being offered in official circles that initial development for the 156-in. and the 240-in. dia. solid-propellant rockets also may be kicked off with Fiscal 1962 funds. However, industry observers feel that these developments, projected for utilization in National Aeronautics and Space Administration programs, are not likely, and that immediate emphasis will be placed on development of the 120-in.-dia. motor.

luded as an Air Force buy for use by the Tactical Air Command for reconnaissance, air superiority, interdiction and troop support. Fewer Republic F-105's will be bought. North American twin-jet A3J medium bomber will also join the Air Force inventory serving as a reconnaissance aircraft in place of the Republic RF-105. Another pending decision may result in purchase of the F4H as an air defense fighter for use by the Air Defense Command in place of the Convair F-106. Although the Douglas A4D was expected earlier to be part of the Air Force buy, it is not included in the new requests.

Late last week the actual new money figure for Fiscal 1963 was less than $51 billion, but last minute changes were expected to increase it to that amount.

When general figures were set by the Administration originally, the Bureau of the Budget suggested that $48.5 billion be the target for Defense Department. Increases have been due principally to the international situation and to some extent a desire to boost the economy of depressed areas.

Most radical increase in funding will be for the Office of the Secretary of Defense. New money for Fiscal 1962 was $1.3 billion. The new $2.1 billion figure indicates the broadened influence of the civilian hierarchy, which now has budgeting responsibilities for the Defense Intelligence Agency, Defense Supply Agency, Defense Communications Agency, Defense Atomic Support Agency, the U. S. Strike Command and Civil Defense.

In the past the Air Force has budgeted negligible amounts for purchase and development of non-nuclear aircraft armament. The new $500-million figure for this class of weapons will provide a stockpile for use with F-105's and North American F-100's and with the F4H's. In order to augment the close troop support mission with these weapons in the near future, the Air Force is reported ready to use the Republic F-84 instead of buying the A4D.

Army manpower is set at 950,000 with the proviso that if the international situation worsens, supplemental requests will be submitted. Army originally requested 1,000,000 men. Air Force strength will be 848,000; Navy 640,000 and the Marine Corps 190,000.

Army aviation buy will include the Beech L-23F twin-engine transport, the Hiller H-12E and H-23D helicopters, the de Havilland AC-1 Caribou twin-engine STOL transport and the Grumman AO-1 Mohawk twin-turboprop reconnaissance aircraft.

Industry Fights Planned Patent Changes

By Katherine Johnsen

Washington—Aerospace and electronics manufacturers last week protested proposed changes in Defense Department patent rights regulations as "severe," "unjust," and "further chipping away at the private enterprise system." The changes are to go into effect Feb. 1.

The Aerospace Industries Assn. and Electronic Industries Assn. filed statements with the department urging reconsideration.

Under the major proposed change, the U.S. government would assume rights to sub-license to European governments for NATO production. This would eliminate or sharply reduce the present practice of direct agreements between U.S. firms and foreign governments and firms, which have yielded U.S. industries millions of dollars for licenses and other technical assistance. A Defense spokesman told AVIATION WEEK that one U.S. company earned $8 million from technical assistance on the European production of the Hawk anti-aircraft missile.

Aid to NATO

Defense Department views the change as essential to assure that European nations, now paying for their own arms production, will freely utilize advanced U.S. technology to strengthen NATO military power.

EIA's statement was drafted by Elmer J. Gorn, chairman of the EIA patents and copyrights committee and associate general counsel of Raytheon Co. It said:

"No responsible organization or individual in this country would contend that any private interest should be able to frustrate a decision by the U.S. government to place U.S. advanced type weapons in the hands of our foreign friends and to grant them such patent rights as they may need to produce such weapons. However, to compel the U.S. originator of such weapons to donate his rights, and to deny him any right to obtain fair and equitable payment for such rights, would be unjust."

AIA pointed out that U.S. government sub-licensing to foreign governments would also nullify or "capriciously interfere" with licenses already granted by U.S. firms.

Defense Department may extend sub-licensing to Japan or other non-European friendly nations, but there are no firm plans to do so at present.

The proposal to sub-license to NATO nations would be the second major assumption of sub-license rights by Defense, which traditionally has followed a policy of requiring only non-transferable licenses for government use under its research and development contracts. The first—requested by the White House—gives the department the right to sub-license any inventions in the space field to private enterprise in the communications satellite program (AW Nov. 20, p. 28).

The department views this action, intended to assure that all government knowledge in the space field will be available to private management of a communications satellite system, as voiding one strong argument used by advocates of government ownership.

Industry, though, is worried that Defense Department's authority to sub-license to commercial enterprise in the communications satellite field will be extended to the space field generally and then will extend to other areas.

EIA told Defense that it is deeply concerned with "the sweeping nature and far-reaching effects" of the sub-licensing provision in all space-related contracts and that the impact on electronics firms could be very severe."

When the patent rights of firms are taken away by government sub-licensing, the firms should be compensated just like a property owner whose property is seized for public purposes, EIA said.

"It is only this traditional form of protection which has prevented overzealous public officials from seizing large quantities of private property for public use where such seizure was not really justified," EIA commented. "We believe the same principle should be followed in . . . the expansion of the patent rights . . ."

Defense Department Aim

Defense Department's political strategy on patents is directed at averting any legislation at all. The department has decided its patent policies by regulation under a general law enacted in 1926, and it much prefers this freedom to determine its own policies.

The department is confronted with the fact that all legislation with patent provisions passed by Congress over the past two years has stipulated government title to all inventions, giving a contractor no title rights unless the rights are waived by the government. This provision, sponsored by Sen. Russell Long (D.-La.), was included in the Coal Research Act of last year, the Saline Water Conversion Act and the Arms Control and Disarmament Act passed this year, and the Marine Sciences and Research Act passed by the

Beech Turboprop Executive Airplane Near Mockup Stage

Beech's twin-engine, turboprop executive transport is near the full-scale mockup stage after completing wind tunnel tests. Aircraft, shown above in model form, will weigh approximately 12,500 lb. and will cruise at 300 mph. at 25,000 ft. French Turbomeca Bastan 4 engine currently is leading contender to power the aircraft, but no firm choice has been made. Aircraft probably will utilize bonded honeycomb materials. Target cost is approximately $400,000 or $500,000 with complete electronics, including radar.

Senate and now pending in the House.

EIA's Board of Directors, at its meeting last month, expressed alarm over the Long provision. In its statement last week to Defense, EIA said that the association "is aware of the pressures and burdens which certain members of Congress have been imposing on the Department of Defense to justify [its] policies . . . we recognize that the department has done an outstanding job of developing these policies so as to be fair both to the contractor and to the government. The department should not be left alone to justify those policies which recognize certain rights in the contractor and this association stands ready to assist you in any way in explaining and justifying such policies to Congress."

Defense Department's first step toward bringing its patent policy in line with at least one expression of congressional policy was taken in January. The department modified its practice of automatically letting title to inventions go to the contractor, and reviewing only a license.

The department now reviews contracts under a set of criteria to determine whether it should assume title. This policy coincides with legislation amending the patent provisions of the National Aeronautics and Space Act which was passed by the House in 1959, but killed in the Senate.

Support for a change in the patent law which gives National Aeronautics and Space Administration title to all space inventions has steadily dwindled over the past two years.

Defense maintains that in practice, its patent policies are no more liberal to the contractor than those of NASA, since NASA waives its right to title in 95% of the cases. Industry's apprehension is that NASA may not always be so liberal in waiving its rights.

The Defense Department proposes to put into effect Feb. 1 two other changes in licensing:

• **Eliminate the "no competition"** provision which bars Defense from using its royalty-free license to compete with private enterprise. Defense considered the elimination "purely technical," since the department does not intend to go into competition with private industry.

In addition, Defense said, the provision "is a definite liability in that it requires an explanation to Congress from time to time and there is no good operational explanation as to why it serves any useful government purpose." AIA and EIA urged retention of what they called "this safeguard against competition from the government."

• **Eliminate provisions** under which prime contractors may now obtain time extensions and price increases due to difficulties in negotiating government-required patent provisions with subcontractors.

Defense Department stated that the procurement personnel of the three military departments were in complete agreement that these provisions had led contractors to request such price and performance relief "without just cause or adequate effort."

AIA and EIA called for a less drastic solution. "To preclude all legitimate requests for delivery extensions and price increases because of the misbehavior of a few seems to be a very radical and unwarranted solution of the problem," EIA declared.

EIA called the generality of Defense Department's criticism of industry "particularly disturbing," and said that the association "cannot believe that any substantial number of contractors were abusing their contract rights. . . ."

New Altitude Record Is Claimed for F4H

Navy claimed a new world's record for horizontal flight at sustained altitude Dec. 5 when a F4H Phantom 2 jet fighter flew 1,400 mph. at 66,443.3 ft. Cdr. George W. Ellis flew the aircraft over the California desert near Edwards AFB.

The claim has been filed through the National Aeronautic Assn. with the Federation Aeronautique International in Paris, the international governing body for aviation records. FAI rules for such altitude records require the aircraft to leave the 15 to 25 km. course flying at least as fast and as high as when it entered the course. A record of 55,300.95 ft. was claimed Nov. 12, 1961 by Jacqueline Cochran—**first pilot** to claim a record in this new category.

Navy has also claimed a Sikorsky HSS-2 anti-submarine **helicopter** set three closed-circuit world speed records on a course along the shore of Long Island Sound between Milford and Westbrook, Conn. The claims are:

• **Closed 100-km. course—182.8 mph.** Existing record of 174.897 mph. was also set by an HSS-2 in May, 1961.

• **Closed 500-km. course—179.5 mph.** Record of 148.449 mph. held by a Bell HU-1 was set in July, 1960.

• **Closed 1,000-km. course—175.3 mph.** Existing record was set by a Sikorsky H-34 in July, 1956.

USAF Studies Army's Space Capabilities

By George C. Wilson

Washington—New military space alliance may emerge from an all-day meeting in Huntsville, Ala., this week when the Army briefs top Air Force officials on what it could do in space if the services were given a bigger role to play.

Current plans for the Dec. 14 meeting do not include the Navy. Air Force officials slated to attend the meeting include Gen. B. A. Schriever, commander of the Air Force Systems Command, which handles most of the space research and development done by the military. Gen. Schriever has been arguing for a much larger military space program and may decide to combine efforts with the Army.

Other Air Force officials scheduled to attend include Lt. Gen. Howell M. Estes, Systems Command deputy for aerospace systems, and Maj. Gen. Osmond J. Ritland, commander of AFSC's Space Systems Division (AW Sept. 25, p. 89). An Army spokesman said Gen. Estes asked for the briefing.

Maj. Gen. August Schomburg, head of the Army Ordnance Missile Command, will be chairman of the meeting. He aroused USAF interest in the Army's capabilities during the recent Air Force Scientific Advisory Board meeting by listing his service's actual and potential accomplishments in space (AW Dec. 4, p. 25).

At that same meeting, Gen. Schomburg distributed a 202-page report entitled "U. S. Army Capabilities in the Space Age." The report was authorized by former Army Chief of Staff Maxwell Taylor and completed in June, 1959. Maj. Gen. John B. Medaris who has since retired as AOMC commander, Wernher von Braun and Dr. Ernst Stuhlinger directed the report's preparation.

Although the report is more than two years old, it will serve as the foundation for the Army's presentation to the Air Force. The report was written when the Army still had its missile development team, headed by von Braun, and Jet Propulsion Laboratory. Both are now under the National Aeronautics and Space Administration. Even so, Army officials consider many of the report's conclusions still valid and will repeat them at the briefing.

The report is not secret but has never been released to the public. Its introductory chapter asks for recognition and utilization of Army space capabilities in these terms: "The magnitude of our dual dependence on technology for both military and peaceful purposes demands economy in the expenditure of our national effort. To effect that economy, national space programs must take advantage of all available resources, particularly those which have demonstrated their capability and which offer even greater potential."

After listing the space accomplishments of the Army's technical services —chemical, engineer, medical, ordnance, quartermaster, signal and transportation corps—the report concludes that those services should be used in the U. S. space program. Leaders in each of those services will update the accomplishments at the upcoming meeting.

Here are the major arguments contained in the report and expected to be repeated at Huntsville:

• **Chemical Corps,** because of its experience, "can provide the answers to many problems which will arise as man reaches into space," specifically in such fields as measuring beta and gamma rays and analyzing the physical and chemical properties of planetary surfaces. The corps also cited its work in determining the effects of nuclear weapons.

• **Engineer Corps'** "existing facilities and body of trained engineers and scientists are capable of handling many space projects in-house or by contract and are also capable of expanding to meet more complex requirements." The report said the Army Map Service which is now mapping the moon, could also map the planets. The Engineer Corps also has had considerable experience in developing compact nuclear reactors.

• "**Army Medical Service** experience and capability in problems of closed space, such as submarines, in acceleration and deceleration, and in variations in atmospheric pressure and composition, have been small compared to that of the medical services of the Navy and the Air Force. On the other hand, Army experience and capability in the field of infectious disease, environmental stress, nutrition, metabolism, physiology and psychology have been exceedingly extensive. Much of this broad experience and capability is directly related to solution of space problems. . . . The Army Medical Service is prepared to provide the required medical service, in terms of research to meet problems now known and those as yet not identified with space travel and operations. It is concluded that the Army Medical Service can contribute significantly to solution of the biomedical aspects of space exploration."

• **Ordnance Corps** projects in the missile and space field "have demonstrated Ordnance's immediate, reliable response to the urgent demands of national space programs." The report cited the corps' success with the Corporal, Nike Ajax, Nike Hercules, Honest John, Little John, Redstone and Jupiter missiles; Explorer satellites, and the Saturn and Juno 2 programs. "Ordnance's integrated research, development, production and support activities give its managerial elements an unrivaled skill in technical judgment. This is the unique and proven skill of ordnance," the report said. The Army Ordnance Missile Command would like to conduct research in such areas as terminal guidance and control; anti-satellite defense, including a defensive satellite; ionosphere investigation; "a comprehensive program to cover all aspects of ballistic missile defense," and an investigation of advanced solid propellants.

• "**Quartermaster Corps** is confident that through food, clothing, personal equipment and supply procedures it can continue to maintain man's operational efficiency unimpaired wherever it proves feasible to send him in space." The report said the corps could develop algal and hydroponic systems for food production and oxygen regeneration.

• "**Signal Corps** has the capability and the facilities to plan, design, develop, purchase, manufacture, install, maintain and operate communications systems of any degree of complication and extent, and to perform the necessary research support."

• "**Transportation Corps,** with its unequalled ability in cargo and personnel movement and control, with its pioneering in special operations in extreme environments, and with its unique capability in research and development of off-road vehicles for use in these environments, is admirably suited to assist the national space program. Transportation Corps participation would benefit the nation in this effort, as it is the only military agency in the Department of Defense which is exclusively oriented to transportation problems."

Zeus Third Stage Tested

The "jet-head" solid propellant third stage of Army-Western Electric-Douglas Nike Zeus anti-ICBM has been flight-tested for the first time at White Sands Missile Range, N. M. Army called the three-stage test a success. Test objectives were limited by the size of the White Sands range. Full range tests including jet-head operation (AW Nov. 27, p. 29) are scheduled soon at Pt. Mugu, Calif., with the support of the Pacific Missile Range. The jet-head motor fires through nozzles in fin trailing edges to provide final stage propulsion and jet reaction control power at high altitudes.

Army Plans Hummingbird Tests in 1962

Augmented ejector-type turbojet propulsion system, aimed at providing maximum simplicity for ease of operation and maintenance in the field, characterizes the Model 330 Hummingbird vertical takeoff and landing vehicles.

Lockheed-Marietta is building the vehicles for evaluation by the U. S. Army in 1962 (AW Oct. 16, p. 88).

Dual-purpose pair of Pratt & Whitney JT12-A3 turbojet powerplants also provide conventional propulsion, following transition from takeoff, with high-speed capability estimated as having a potential of well over Mach 0.68.

Initially, two experimental research aircraft, identical in external and aerodynamic configuration to the proposed operational Army surveillance sensory equipment platforms, will be flight tested. Based on a Lockheed-Marietta master planning schedule, the first test vehicle would take nine months from go-ahead to rollout, the second would follow approximately two months later. One plan shows these occurring in March and May, 1962, respectively, with first flight, following extensive ground trials, possible in June. Flight test period could be concluded in early September, 1962, the company estimated.

Lockheed-Marietta's Hummingbird seats two, side-by-side, with ejection seats permitting escape at speeds of up to 450 kt. Engineering test data and other equipment would be located in nose and rear compartments.

The P&W JT12s are located over each wing root, with the main ejector ducts for vertical takeoff and landing located in the upper portion of the center fuselage. The ejector thrust line is directed rearward at an angle of 12 deg. from the fuselage vertical reference line. This angling is planned to provide a minimum time for flight transition.

Total fuel capacity of approximately 260 gal. is in the mid fuselage under the main ejector ducts and between the ejector mixing sections.

Propulsion system basically consists of diverter valves to direct the exhaust gases aft for conventional flight, or into the main ejector ducts for the VTOL condition. The main ejector ducts run fore and aft on the airplane center line, feeding a series of transverse ducts which direct the gases down into ejector mixing sections for vertical thrust. With each engine supplying alternate banks of nozzles, there would be no tendency for the airplane to pitch or roll if the turbojets should operate at asymmetrical power levels, or even if there should be failure of a powerplant, Lockheed said.

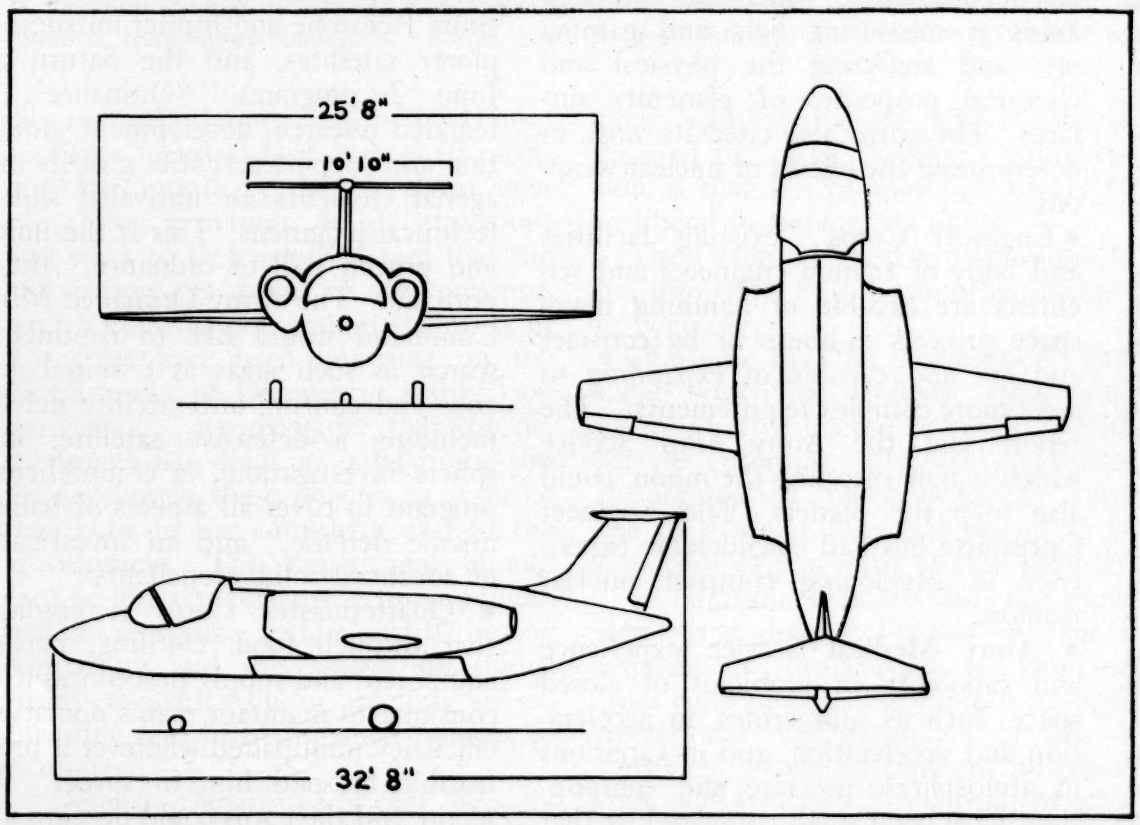
Control of the aircraft during VTOL flight is provided by reaction jets. Engine compressor bleed air supplies thrust to roll control nozzles at each wing tip, engine exhaust gas bleed-off is directed to nozzles at the nose and aft end of the aircraft, yaw control is handled by rotation of aerodynamic vanes in the pitch nozzles.

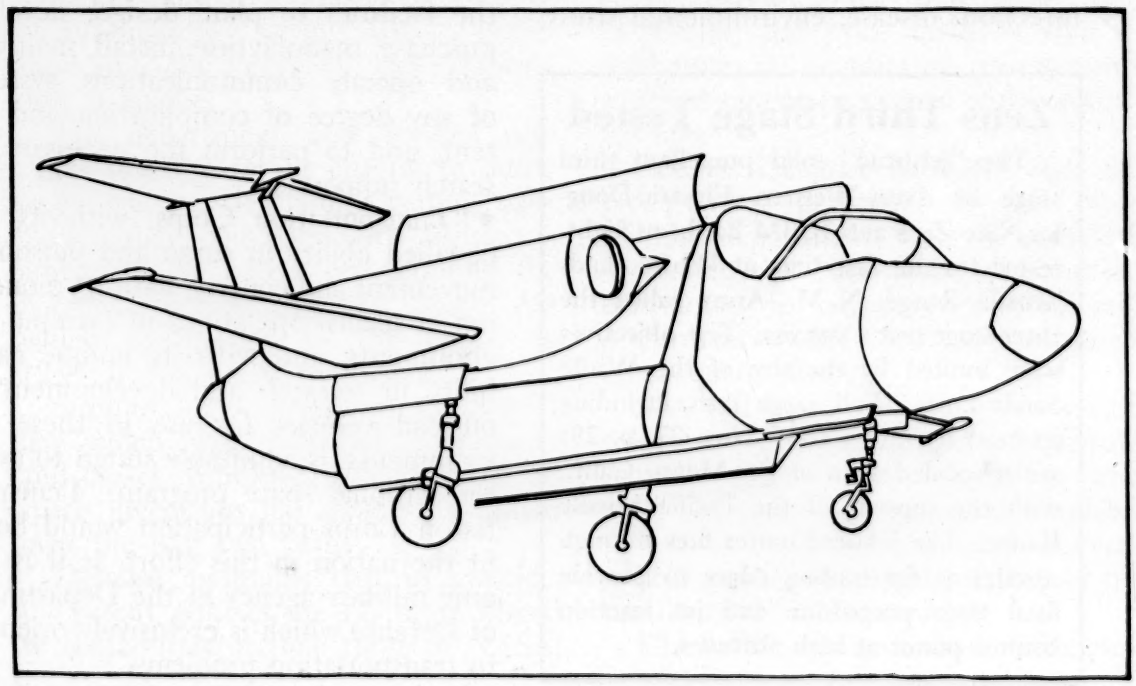
In operation, the sequence briefly would be as follows:

• **For takeoff,** the two-position nose landing gear is extended hydraulically to incline the Hummingbird 12 deg., thus positioning the rearward-inclined thrust component directly downward. After takeoff, the nose is tilted downward to provide horizontal thrust from the ejectors. At a forward flight speed of approximately 80 kt., one of the JT12s is shifted to forward thrust and the airplane is nosed upward to a point where wing lift is approximately half the airplane's weight. Acceleration is continued until the wing is sustaining the aircraft's entire weight. Thrust of the other engine is then directed full aft for maximum forward thrust, or that powerplant is shut down for economical cruise. The ejector doors are closed, making the transition complete.

• **For landing,** both engines are brought to idle power and thrust is shifted downward. As the forward speed of the aircraft decreases, power is increased to maintain altitude.

In considering the problem of ground blast effects of the downward ejecting VTOL propulsion system, Lockheed engineers said that the mixing of secondary air with the primary exhaust gases and





ARMY-LOCKHEED Hummingbird VTOL aircraft is powered by two Pratt & Whitney JT12-A3 turbojets (3,000 lb. thrust). Ejector ducts for vertical lift are in upper portion of fuselage center and are covered by fairings shown in open (VTOL) position below.

Hummingbird 330

Dimensions

Wingspan	25 ft. 8 in.
Wing area	104 sq. ft.
Horizontal tail span	10 ft. 10 in.
Over-all length	32 ft. 8 in.

Weight Summary

Wing	401 lb.
Empennage	187 lb.
Fuselage	1,065 lb.
Landing gear	310 lb.
Nacelle	272 lb.
Propulsion	1,604 lb.
Instruments	65 lb.
Controls	333 lb.
Electrical	527 lb.
Hydraulics	80 lb.
Furnishings	151 lb.
Weight empty	4,995 lb.
Crew	200 lb.*
Flight test equipment	300 lb.
Trapped fuel and oil	30 lb.
Equipped weight empty	5,525 lb.
Fuel	1,675 lb.
Gross weight	7,200 lb.

*** Crew weight is based on carrying one pilot plus the 300 lb. of flight test equipment. Operational crew would consist of two men.**

the configuration of the outlets markedly reduces exhaust velocities and also noise levels. Jet temperatures are lowered from approximately 1,200F to 500F and exhaust velocities are lessened similarly. A test rig has been hovered over various types of surfaces without apparent damage to them. Noise levels are down 12-15 db. from the levels of conventional pure jet engines, Lockheed adds.

As regards ground cushion effects of the downward thrust component, Lockheed estimates the Hummingbird will experience this effect starting at approximately 20 ft. off the surface.

Hummingbird is designed for a cruise speed of Mach 0.53, with design dive speed selected as Mach 0.68. The airplane is expected to have capabilities well over the dive limit speed.

Sea Level Climb

Sea level rate of climb at the maximum vertical takeoff gross weight of 7,200 lb. is close to 4,000 fpm. on one engine, according to Lockheed, and is estimated at approximately 12,000 fpm. on both engines.

Estimated data on radius and range at sea level cruise speeds, depends upon the amount of test equipment carried. A warm-up and takeoff fuel allowance of 1.5 min. at military power and a reserve allowance of 10% of initial fuel load is considered. Based on these data and a thrust-to-weight ratio of 1.05 at vertical takeoff on a sea-level standard day condition, with no allowance for hover time, the range capability is given as 290 naut. mi. at sea level, carrying 300 lb. of test equipment. A corresponding radius would be 145 mi., considering no mid-point landing. Lockheed estimates that at 15,000 ft. cruise altitude, a ferry range of 520 naut. mi. can be achieved with 125 lb. of test equipment aboard.

Conventional Takeoff

Utilizing conventional takeoff techniques, the Hummingbird will clear a 50-ft. obstacle in 2,070 ft., with takeoff roll of 1,530 ft., Lockheed-Marietta estimates. For conventional landing, with both engines at idle power, flaps down, and at a weight of 5,500 lb., the total distance required to clear a 50-ft. obstacle would be 3,250 ft., with required ground roll taking 2,120 ft.

Initial research program on the Hummingbird project included wind tunnel models and a flying test rig. Wind tunnel testing was done with an 18% scale model of the aircraft in the University of Maryland's low-speed facility in 1959. The tests generally confirmed calculated characteristics, although the tunnel dictated a change to a T-tail.

Ejector Trials

Hummingbird test rig was constructed following small-scale ejector trials. This rig was at first powered by two 1,000-lb. thrust Fairchild J44 turbojets and was capable of lifting more than 2,600 lb. Pitch and roll control nozzles had to be supplied with compressed air through hoses, since the J44s were not designed to provide compressor bleed air, which would be used for this purpose.

Conventional stick and rudder pedals were used for operating the reaction controls and an autopilot was installed to augment roll and pitch stability. Once test pilots learned to fly the rig, the autopilot was unnecessary.

Later in the test rig program, Continental J69 turbojets were fitted to demonstrate the feasibility of the complete system and this rig was successfully operated for a period of more than two years.

Bullpup B Test Set

First flight demonstration of Navy's Martin Bullpup B is scheduled to be conducted from Pt. Mugu, Calif., this month, using a Douglas A4D as the launcher, in qualification tests expected to be completed before the end of the year.

Bullpup B powerplant is Thiokol Chemical Corp.'s Reaction Motors Division YLR62-RM-2 packaged liquid-propellant engine using mixed amine fuels and inhibited red fuming nitric acid, and developing approximately three times the thrust and total specific impulse of the Bullpup A packaged engine.

Production of the YLR62-RM-2 engine tentatively is targeted for spring, 1962.

According to a Navy spokesman, the Bullpup A powered by Reaction Motor's LR-58-RM-4 packaged engine is the first missile released for tactical use fully meeting storage and operational temperature requirements of military standard 210A. Bullpup B's YLR62-RM-2 engine is expected to meet the same requirements.

Snecma to Develop Version of JTF-10

Paris—French state-owned engine company, Snecma, is undertaking a development program for the Pratt & Whitney JTF-10 turbofan engine for eventual use in three French aircraft.

Snecma, in which Pratt & Whitney division of United Aircraft Corp. has roughly 10% stock interest, plans to develop an afterburning unit for the JTF-10. This will increase the engine's present takeoff thrust of roughly 10,000 lb. to 18,000 lb. Snecma will designate the modified engine the TF-106.

Main French interest in the TF-106 project centers on its VTOL fighter project, the Dassault Mirage III-V Balzac (AW Nov. 20, p. 23). First Balzac prototype is scheduled to fly next June. The aircraft is France's main entry in NATO's VTOL fighter competition. The French Air Ministry also is interested in Balzac as a possible national production program.

The initial Balzac prototype, smaller in size than the projected production model, will be powered by eight Rolls-Royce RB.108 vertical lift turbojets and one Bristol Orpheus turbojet for forward flight. A larger production version reportedly will be powered by RB.162 vertical lift turbojets plus the afterburning Pratt & Whitney JTF-10.

A second French project design centered on the JTF-10 is Dassault's entry in NATO's V/STOL light transport competition. Dassault transport would use two JTF-10s, without afterburning, for forward flight. The plan here is that the light transport, scheduled to carry out cargo support missions for the VTOL fighter, should be powered by the same engines as the fighter.

A third possible French use for the afterburning JTF-10 is in Dassault's Mirage IV twin-jet bomber. Fifty Mirage IV bombers are on order for the French air force and by installing JTF-10s in place of the aircraft's Snecma afterburning Atar 9s, which each deliver about 13,500 lb. thrust, the French think they would get a substantial increase in performance, notably in range.

Study Urges Less Reliance on Computers

By Philip J. Klass

Washington—Important changes in concepts and procedures used to develop semi-automatic command and control systems have been recommended to the Defense Department by an Institute for Defense Analysis (IDA) task force.

The group studied the problem for four months at the request of the Director of Defense Research & Engineering.

The report by the nine-man task force, headed by Marlin G. Kroger, suggests that too much emphasis has been placed on computers and hardware and too little on analysis of the command functions which the system is to automate and on the role of military personnel in the system.

"Analyzing and understanding the information needs of a command, and developing an appropriate system growth pattern, are much more important to the early and continuing success of an automated command information system than are such matters as the choice of a particular computer," the report said.

The personnel of a military command who will use the system are a vital element and should be intimately involved in the design and development of the computer-aided command information processing system which they subsequently will operate, the task force said.

If responsibility for controlling system evolution is delegated to an agency outside the command, "there is danger that the command will depend on automated decision aids without realizing the extent to which human judgment of operational parameters has been built into such aids by the outside developer," the report warned.

Additionally, an outside development agency lacks intimate understanding of the command itself, its functions and problems, which themselves may be undergoing continuous rapid change or evolution.

However, this will require a sharp increase in the technical capability of personnel in operational commands to provide the direction and guidance required in system development, the task force warned. This capability must be acquired within the command line. Those outside the command line with this technical competence must have a "close, two-way working relationship with the command at all levels, particularly at the top," the report said.

The recent Air Force decision that Systems Command's Electronic Systems Division would assume increased system engineering and management responsibility on the new Norad Combat Control Center (425-L), and future such systems, indicates that the Air Force already had recognized the need for some of the changes recommended in the IDA report. User commands have had representatives in the USAF System Project Offices, but officials privately concede that increased user command participation is needed in the development stages.

The primary limiting factor in the application of automation to command systems is not hardware but "software"—the state of the art in problem formulation, analysis, modeling and command languages, the IDA group concluded. Currently available computers which can provide up to 500,000 operations per second and 500,000 words of high-speed storage, are adequate for command system applications.

The report said there is a lack of coordination between individual service automation efforts, and often between the services and the unified and specified commands, which results in technical and functional incompatibilities between their command systems. The task force recommended that improved means for coordinating such systems be established within the Defense Department to improve compatibility.

Standardization Needed

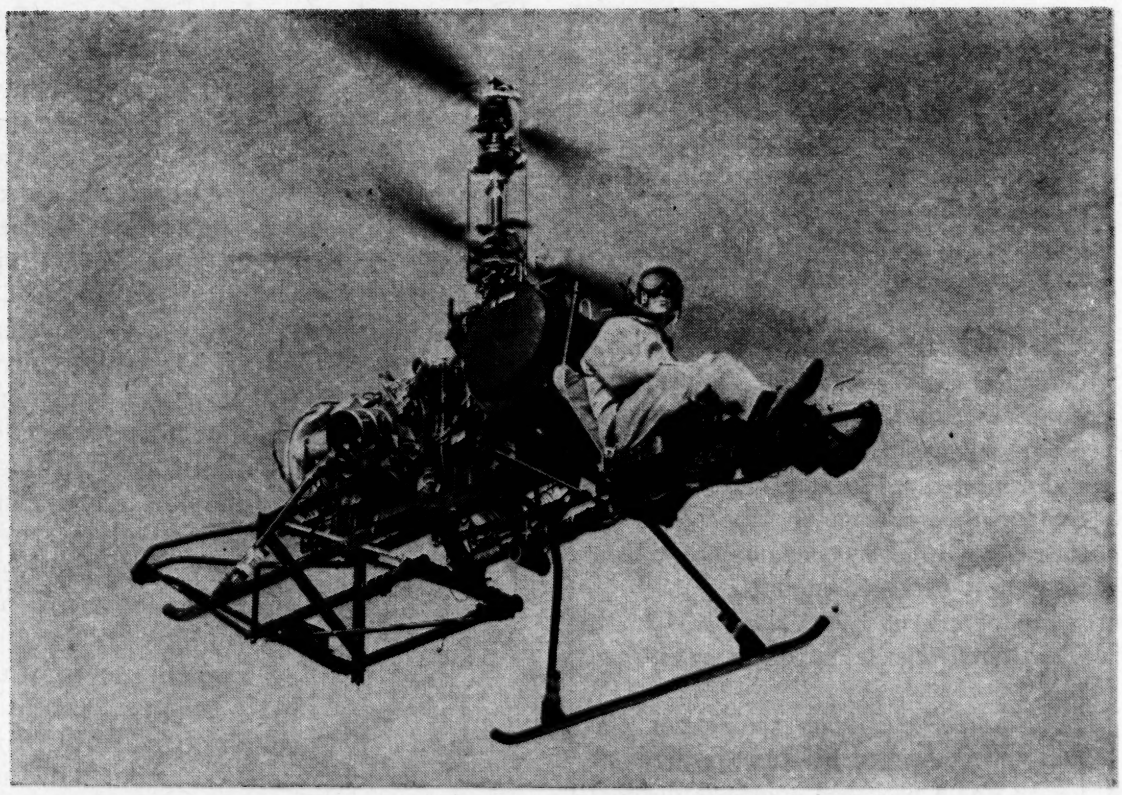
Although there is need for standardization of computer hardware and language, the IDA task force cautioned against attempts to standardize command and control system configurations because of the "striking differences between commands."

The report urged the adoption of a family of standard modular, general-purpose machines which can be assembled into a wide range of systems. These should be developed and improved as the state of the art advances and made available for off-the-shelf procurement.

"Only recently has it become apparent that problems in inter-system and intra-system compatibility are mainly problems of language," the task force said. The particular language and terminology used by a command have developed through the years for its particular type of operations, and usually differs from that of another command. This has often resulted in failures of liaison between commands.

The introduction of computers has aggravated this problem, particularly if two or more commands share the same command and control system. A computer can be programed to understand a language only if it can be defined precisely and clearly.

At present there are three different computer programing languages in use. Jovial, devised by System Development Corp., is planned for use in most Air Force systems, in the Navy Spasur (space surveillance) and the Defense Department's Damage Assessment Center (DODDAC); Nelliac, devised by Naval Electronics Laboratory, which will be used in the Navy Tactical Data System and several Army systems, and



DSN-3 Drone Undergoes Manned Flight Tests

First photograph of the Gyrodyne DSN-3 anti-submarine warfare drone helicopter shows the vehicle undergoing manned flight test. Airframe is modified to accommodate pilot. The DSN-3, powered by a Boeing T50-BO-4 turbine engine rated at 270 shp., will carry two homing torpedoes between skids and will operate from destroyers.

Kiwi Reactor Tests

Kiwi-B 1-A test reactor of NASA-AEC nuclear rocket Project Rover will resume program tests soon if a complete system check reveals no reactor damage due to a hydrogen explosion in its portable shelter on Nov. 7.

Project scientists at the AEC Nevada test site have decided not to make a complete internal check of the reactor because disassembly of it would delay the test program too long. No damage to the main part of the reactor is visible. Auxiliary pipes and instruments destroyed by the blast are now being restored.

The explosion occurred a few hours before a scheduled power run when a leaky valve allowed hydrogen to surge through the reactor and accumulate under the roof of the shed where it ignited. Nine persons were injured, none seriously. No radioactivity was reported. AEC officials say equipment checks and procedures are being reviewed to prevent a recurrence of the accident.

the CL-2, devised by Technical Operations, Inc., for use in Air Force Project Omega.

To permit interchange of information between all such systems, and to achieve a single standard for the future, the IDA task force recommended developing a new command program language which would be a blending of the three.

The IDA task force also called for a new philosophy of system development and operational use which is more evolutionary than in the past. Instead of suddenly introducing a large, complex automated command system into a user command in a single operation, the system should be designed to permit implementation in well-planned easy stages.

Early in the program the user command should be given some limited computer capability which automates one phase of its command functions, enabling it to gain experience with the new hardware and techniques. Then additional functions can be automated in time-sequence steps.

The task force recommends that funding and procurement practices should recognize that an evolutionary program of this sort has no operational cut-over date when the system development stops and it becomes fully operational. At each stage in system growth, it should either have unused capacity or the ability to be quickly expanded for added duties.

The task force cautioned against adopting automation for its own sake. "At every stage of evolution, the value of improvement through automation should outweigh the penalties paid for the use of the equipment," the report said.

Much greater attention should be given to the operational capability of automated command systems in the event that portions of the system are destroyed or damaged in an initial enemy attack, the task force warns.

Where formerly there has been considerable emphasis on centralized command and control systems—and these often are desirable prior to an attack—the system must be designed to permit decentralized control by local commanders in the event communication links are destroyed, the task force said.

The report also said that automated systems must be designed to provide greater capability for exercising the system and the command with realistic war games. Systems should have built-in means for self-evaluation of the results of the exercise and for appraising the value of design changes in the system. Such capability also should include provisions for introducing failures and performance degradation in the system, to simulate after-attack operating conditions.

Navy Plans Increase In Micro-Electronics

Washington—Sharp increase in Navy's micro-electronics research and development effort has been recommended by its Panel on Micro-Electronics, representing all of the Navy's major bureaus and agencies.

The panel recommended that primary emphasis be placed on thin-film techniques, particularly those which show promise of producing active (amplifying) elements. The broad-ranging program, encompassing research, development and application, is estimated to cost approximately $7.5 million if approved. This is several times the amount the Navy is now spending in the micro-electronics field.

The planned program is the result of two years study by the panel of the variety of micro-electronic and molecctronic approaches now under investigation, with Air Force, Army and private industry funding. The study indicated that the Navy could make most effective use of its limited funds by supporting work in the new thin-film techniques area.

In selecting promising thin-film and micro-electronics research programs to support, Navy is expected to prefer those for which industry itself is willing to provide partial funding, according to Richard E. Wiley, Office of Naval Research. Wiley is executive secretary of the Navy panel, which is headed by Dr. Arnold Shostak, director of ONR's electronics branch. Panel members have visited Army Signal Corps Laboratories and USAF's Aeronautical Systems Division to determine which areas already are receiving government funding, to avoid overlap in the Navy effort.

The program includes studies of all types of Navy equipment to determine where the new techniques might find the greatest payoff, Wiley said.

Another aspect of the proposed program would seek to develop standards for micro-electronic circuitry. For example, a preliminary standard recently prepared suggests that unrepairable modular assemblies should not exceed $200 in production quantities, and a figure closer to $25 is preferable. Modules would be designed to operate from standard voltages (1½, 3, 6, 12 and 25 v.), and dimensions would be standardized in multiples of 0.2 in., with 0.4 in. as the minimum dimension.

Army Cites Shortages Of Support Equipment

St. Louis—Ground support equipment shortages and delivery delays are the prime problems hampering Army's effort to phase in new or modified aircraft as combat-ready weapon systems, ranking Transportation Materiel Command officers charged here last week.

Development of necessary ground support equipment typically does not start until new aircraft are accepted and delivered to field units that will use them, officers said at Transportation Materiel Command's Army-industry aviation logistic symposium. As a remedy, they urged that the building of an aircraft to Army specifications begin concurrently with the design and development of ground support equipment needed to sustain it in the field.

Because Grumman did not design the AO-1 Mohawk observation aircraft around existing ground support equipment, Bert C. Stein of TMC's directorate of engineering said, field units must try to keep the plane operational with inadequate equipment. The AO-1's mission and function have been jeopardized as a result, Stein said.

Dry air compressors, oxygen servicing trailers and external auxiliary power units, Stein said, are specific examples of what the AO-1 lacks in the way of ground support equipment.

Grumman and other manufacturers' representatives at the symposium countered with these points:

- **Army's failure** to define what ground support equipment it wants for a specific aircraft is responsible for such shortages.
- **No single source** is available to tell suppliers what ground support equipment Army already stocks in its inventory and duplication is the result.
- **Army indecisiveness** in approving manufacturers' requests to design special tools to support their products compounds the problem.

Renegotiation Board Case Backlog Eliminated by Shift in Procedure

Washington—Renegotiation Board for the first time in its history is abreast of its work load rather than burdened with a backlog of pending cases, according to Chairman Lawrence E. Hartwig.

This will stand the board in good stead when Congress next year considers legislation to extend the Renegotiation Act beyond its June 30, 1962, expiration date. The board has long been criticized for delay in disposing of pending cases.

Under the law, contractors who in one fiscal year received contracts of $1 million or more from certain government agencies must file financial statements by the first day of the fifth month after the close of the contractors' fiscal year. These agencies are the Atomic Energy Commission, Defense Department and military services, Federal Maritime Board, General Services Administration, Maritime Administration and NASA.

The Renegotiation Board has one year after the statements are filed to start negotiations to recover what it considers excess profits made on the contract. Once the negotiations are started, the board has two years to complete them.

When the Renegotiation Act was last extended by Congress, Chairman Carl Vinson (D.-Ga.) of the House Armed Services Committee was prominent among those decrying this time lag. He said it would be beneficial to tighten up the time so that both the government and contractor would experience a shorter period of uncertainty.

Hartwig, who became chairman of the Renegotiation Board Apr. 13, told AVIATION WEEK the backlog was wiped out primarily by screening contractors' financial statements more thoroughly at headquarters instead of sending the cases to the regional offices for disposition. He estimated that 70% of financial statements under present procedures are screened out at headquarters and the contractor notified that the board decided profits were not excessive.

The active cases pending decision declined from 1,112 at the end of 1960 to 865 by the end of May, 1961. In the six months since May, Hartwig said the board has wiped out all but a few of the long pending cases.

Although the Renegotiation Act expires next June, it is all but certain Congress will extend it. The original legislation establishing the independent Renegotiation Board became law Mar. 23, 1951, and has been extended ever since—most recently July 13, 1959. There will be attempts to amend it. One possibility is an amendment granting immunity from renegotiation to some types of incentive contracts.

The Kennedy Administration is trying to broaden the use of incentive type contracts (AW Nov. 20, p. 26). Defense Department leaders want to write contracts that reward superior performance by contractors and penalize inferior work. But they are concerned such rewards may be considered excess profits by the Renegotiation Board and be taken away from the contractor.

The newly created Logistics Management Institute (AW Dec. 4, p. 30) is among those groups pondering how to resolve this possible conflict. It appears Defense leaders will try to reach an understanding with the board rather than try to specify immunity in the Renegotiation Act. Such an arrangement would be easier to achieve. Also many procurement officials look upon the renegotiation process as a chance to correct mistakes made when the contract was signed.

Rep. Vinson will fight any major revision of the Renegotiation Act. Because of his expert knowledge of the entire defense contracting field, the congressman's views carry considerable weight.

29 Firms Asked to Bid for Rift

Washington—Twenty-nine companies have been invited to participate in a preliminary competition to design and develop a nuclear engine rocket stage which could grow into a $200 million contract calling for production of 30 to 40 vehicles.

The stage is called Rift, for Reactor in-flight test, and will be powered by the Nerva nuclear engine being developed by an Aerojet-Westinghouse team (AW June 12, p. 32). Rift will be test flown in five to six years as the second stage of a Saturn C-1 vehicle.

In an unexpected move, the National Aeronautics and Space Administration will require fabrication and assembly of the Rift stage at the agency's Michoud Operations plant near New Orleans. NASA had previously indicated that Michoud work would be limited to Saturn and Nova first stages.

Decision to build Rift there means that the plant will be occupied by three different prime contractors and a housekeeping contractor. Chrysler Corp. has been awarded the Saturn S-1 contract (AW Nov. 27, p. 22), and the agency expects to award the S-1B and housekeeping contracts within the next few weeks. Rift contract probably will be awarded in March.

The Michoud plant consists of about 2 million sq. ft. of production space.

NASA last week invited contractors to submit step one proposals for the Rift stage, which will be due Jan. 7. Initial proposals will define the bidders' experience and capabilities. NASA will trim the list and invite five or six firms to make detailed proposals on cost and technical approach based on complete specifications to be given at the end of the first proposal. NASA said it is using the two-phase evaluation to keep the industry proposals cost at a minimum.

Companies invited to attend the initial conference, held Dec. 7 at Marshall Space Flight Center, were Avco, Boeing, Bell, Beech, Bendix, Chance Vought, Chrysler, Douglas, Ford, General Dynamics/Astronautics, General Electric, Goodyear, Grumman, Hughes, Lockheed, Martin, McDonnell, North American, Minneapolis-Honeywell, Northrop, Raytheon, Republic, Ryan, Space General, Space Technology Laboratories, Sperry Rand, Temco Electronics, United Aircraft and Westinghouse.

Last week, the Atomic Energy Commission and NASA began negotiations with Aetron Division of Aerojet-General Corp. for architectural and engineering services for the Nerva down-firing test stand to be built at Jackass Flats, Nev. Aetron was one of 21 companies that submitted proposals for design of the stand, which will cost an estimated $ million.

The stand will have a 40-ft. square superstructure with a neutron shield and will handle reactors with propellant tanks as large as 36 ft. in diameter. It will incorporate a high-pressure steam injection system to simulate altitude pressures up to 80,000 ft.

The test stands used in the Kiwi reactor series can accommodate only upward-firing vehicles.

Indian Helicopter Bid

Paris—Indian bid for a license to build several hundred Sud Aviation Alouette helicopters still is in earliest phase.

Team of engineers from Sud and Turbomeca, the engine manufacturer, returned from India last week convinced the Hindustan aircraft plant at Bangalore could produce the Alouette and the Artouste turbine that powers it. The technical decision clears the way for negotiations between French and Indian governments to arrange financing. The deal hinges, it is believed, on French government willingness to grant long-term credits for the project.

X-15 Personnel Have Big Role in Apollo

By Edward H. Kolcum

Washington—North American Aviation's Space and Information Systems Division and the National Aeronautics and Space Administration will begin negotiations today to settle Apollo spacecraft contract details which are expected to be made formal by Jan. 1.

Negotiations follow by 13 days selection of North American to build two of three modules in the three-man vehicle and to integrate its systems (AW Dec. 4, p. 26). Company representatives discussed the negotiation agenda Dec. 4-5 with NASA Manned Spacecraft Center officials at Langley Field, site of negotiation talks. The meetings beginning today will result in a detailed work statement, method of operation and a definition of responsibilities.

Harrison A. Storms, president of Space and Information Systems Division, told AVIATION WEEK that an Apollo group will be formed within the division and will draw heavily on key X-15 personnel for the management core of the new group. The group will be headed by John W. Paup, an electronics expert who worked for North American and Sperry Rand and returned to North American several months ago.

Key X-15 project officials already transferred to Project Apollo include Charles H. Feltz, to be chief engineer; N. T. Scott, who will head the quality assurance branch, and F. C. Hung, M. R. Kinsler, Scott Crossfield and Q. C. Harvey.

Storms said North American will require only limited new facilities and few additional employes to fulfill the contract. Production will be at Downey, Calif., and extensive use will be made of facilities used in X-15, B-70, F-108 and F-86 programs.

The cost-plus-fixed-fee contract will have an initial value of about $400 million, but NASA said a conservative estimate will be $1 billion during the 7-8 year contract life. North American was low bidder in the Apollo competition, but most feel that the deciding factor in selection of the company was its management capability demonstrated in the X-15 program. Bids ran from North American's low to a high in excess of $800 million, with the highest bids submitted by companies with the largest teams.

North American impressed NASA with its technical ability displayed in its bid on the Project Mercury capsule in a competition won by McDonnell Aircraft Corp. in 1959. However, North American proposed a lifting body, while NASA preferred a ballistic shape. Apollo will be a semi-ballistic shape.

Because the re-entry vehicle is a major part of the contract, many in industry felt that General Electric, a prime bidder, and Avco, an associate bidder with General Dynamics/Astronautics, were the top contenders. General Electric and Avco lead in re-entry vehicle experience. However, Storms said North American was in an excellent competitive position because of its X-15 re-entry experience, which also provided strong backgrounds in heat transfer, communications and human factors.

North American bid as a single company, but its proposal included four suggested top-tier subcontractors. All four are major subcontractors in Project Mercury, and are expected to be approved by NASA. They are Collins Radio, communications system; AiResearch Division of Garrett Corp., environmental system; Minneapolis-Honeywell, flight controller, and Radioplane Division of Northrop Corp., recovery system.

North American is in the process of building its subcontracting structure, and during the next few months plans to consider all firms with a demonstrated excellence in critical fields. This does not rule out prime contractors who lost in the major competition.

NASA retains the right to approve all North American subcontractors, and will manage some of the capsule work itself through the Manned Spacecraft Center.

The Massachusetts Institute of Technology is an associate contractor, and will work through NASA in fulfilling its contract for the Apollo guidance system. Still to be negotiated is whether the winner of the competition for the on-board propulsion package will be an associate or a subcontractor. MIT will develop the prototype guidance system, which will be built under a separate subcontract.

NASA wants to administer the Apollo contract the same way it administers the Mercury contract. As prime contractor, North American will exercise direct management supervision over its subcontractors, and coordinate the work of associate contractors. NASA, which is greatly expanding its manned space flight staffs here and in the Manned Spacecraft Center, will provide executive management for the over-all program, integrate spacecraft and launch vehicle, and arbitrate any differences between associate contractors.

North American will build the crew and logistics modules, and NASA has not decided on the method to be used to select a contractor for the lunar landing module. The agency is leaning toward a separate competition, rather than selecting the contractor from among the four losing bidders in the main competition.

Apollo bidders agree that bid specifications were tight. One said the specifications were among the best ever put out by the government because they reflected a detailed appreciation of the problems. He contrasted this to Mercury specifications, which were considered naive because NASA was new to space hardware, and Mercury was its first major dealing with industry.

Experience in the Mercury program resulted in Apollo specifications so detailed that the real keys to the award were thought to be the management approach, and the capability to accomplish the job.

Pan American World Airways Guided Missiles Range Division, under USAF contract for range support at the Atlantic Missile Range, has formed a manned lunar landing program to support facilities planning, engineering and administration. Apollo will be launched from a site adjacent to AMR.

Soviet Defense Budget

Moscow—Soviet Russia said last week that its 1962 military budget would be 13.4 billion new rubles. Last January the 1961 budget called for an outlay of 9.255 billion rubles but this was increased to 12.4 billion rubles last July. The new ruble, worth about $1.10, was created last January.

Attempts to compare U. S. and Soviet budgets can be misleading because of an artificially set rate of exchange and disguising of Soviet military expenditures in heavy industry accounts. (See p. 26.) But U. S. officials said that the new Soviet budget indicates that both countries are spending about the same for defense.

Depreciation Time May Be Shortened

Washington—Aircraft industry may be able to write off the depreciation on its manufacturing equipment over a shorter period of time under new Internal Revenue Service guidelines due to be issued next spring.

Treasury Secretary Douglas Dillon last week said IRS would announce new depreciation schedules for several industries including aircraft and parts manufacturers, and electrical machinery and equipment manufacturers.

Current IRS regulations consider 15 years as reasonable useful lives for aircraft machinery and equipment and four or five years for small tools. The Kennedy Administration already has shortened the allowable depreciation period on textile equipment.

Manned Orbit Now Planned for Jan. 16

Washington—National Aeronautics and Space Administration will not attempt a manned orbital flight until next month because the agency feels it needs this time to complete its preparations for the mission.

The Mercury Atlas-6 (MA-6) flight, piloted by Marine Lt. Col. John H. Glenn, is scheduled for Jan. 16, with a chance that it can be launched Jan. 9.

The difficult decision was made by Project Mercury officials, who had hoped until Dec. 4 that the flight could be made Dec. 28 (AW Dec. 4, p. 27). Move to delay the mission came from practical rather than technical considerations. Demand on the ground crews to assemble, mate, check-out and launch the MA-6 system 31 days after the MA-5 launch was considered unwise, particularly in view of the exceptional precision required for quality control and checkout of a manned system.

If the launch is made Jan. 9, the NASA-General Dynamics-McDonnell crew will have prepared the system in 43 days, 20 days less than the time required for any previous Mercury Atlas launch.

NASA and McDonnell capsule personnel are working three eight-hour shifts at Cape Canaveral, and overtime is being worked when necessary by the General Dynamics/Astronautics launch vehicle crew. The Atlas vehicle, 109-D, was delivered to the Cape Nov. 30 and erected in the Complex 14 gantry service tower Dec. 2. Vehicle preparation was completed six days later. Initial capsule mating was scheduled late last week.

Early system checkouts on MA-6, which will carry McDonnell production capsule 13, went exceptionally well. One NASA official said the checkout is as smooth as any Mercury checkout to date.

Meanwhile, Col. Glenn and his backup, Navy Lt. Cdr. M. Scott Carpenter, are undergoing final training for the flight. This consists mainly of flying simulated three-orbit missions, and in familiarizing themselves with the flight capsule.

Dr. Stanley White, chief of the Manned Spacecraft Center's Life Sciences Division, said data obtained from the MA-5 flight of the chimpanzee, Enos, is still being analyzed. He said last week that the chimp apparently performed as expected.

Despite the fact that the MA-5 mission was ended after two orbits, NASA believes the entire Mercury-Atlas system is now ready for manned orbital flight. Robert R. Gilruth, director of the Manned Spacecraft Center, said no additional unmanned or primate flights are necessary before the Glenn mission.

New Polaris Goal

Washington—Navy has increased its long-range goal of 45 Polaris missile submarines to 50. Current Defense Department programing calls for 41 of the nuclear-powered subs through Fiscal 1967, but Defense officials encouraged Navy to request the increase.

Associations Urged To Reduce Activities

Washington—Aerospace Industries Assn. has taken action to encourage technical and scientific societies with interests in the aerospace field to eliminate duplication of meetings and related time-consuming activities.

AIA also recommended to its members that participation in exhibitions in the U.S. which are not endorsed by AIA or formally requested by the Defense Department or NASA be eliminated or sharply reduced.

Resolutions passed by the AIA Board of Governors partly reflected desires of Defense officials who want to reduce their number of contacts with industry and trade, professional and unofficial military-related associations (AW Dec. 4, p. 30).

In its statement, AIA supported the concept of strong professionally technical and scientific societies to stimulate progress by exchange of ideas. However, it noted that many meetings, exhibits and other functions overlap and are costly in money and time.

AIA members were requested to screen carefully the attendance of their employes at society meetings, to establish a high standard of quality for the presentation of employes' technical reports and to avoid costly exhibition of company products.

General Dynamics Is Leading Contractor

Washington—General Dynamics Corp., with prime defense contracts totaling $1.92 billion, again led the Defense Department list of 100 prime contractors for Fiscal 1961. General Dynamics has been the major defense contractor in four of the last five years.

North American Aviation, Inc., which was fifth in Fiscal 1960, climbed to second place in Fiscal 1961 with $1.2 billion in contracts. Lockheed Aircraft Corp., with $1.17 billion, was third, and Boeing Co., with contracts totaling $920 million, was fourth.

The 100 contractors received awards totaling $17.3 billion, of which 23% was for missiles and space projects, 20% for electronics and 19% for aircraft.

News Digest

International carriers have continued their drive for group fares despite failure last month to reach agreement at a special traffic conference in London. Carriers are meeting again today in Bermuda in a last-ditch attempt to reach accord on a new low fare level on North Atlantic routes.

Production of the 1,500-naut.-mi. Lockheed Polaris A2 fleet ballistic missile series has started at all contractor plants and the last of the 1,200-naut.-mi. A1 series was accepted by the Navy last week. First stage of the A2, built by Aerojet-General Corp., is 30 in. longer than that of the A1.

British army has ordered several thousand Vickers Vigilant anti-tank missiles, capping a development program that has cost about $5 million in company funds. Order (AW Nov. 6, p. 34) precedes a U. S. Marine Corps evaluation schedule for next spring.

USAF Gen. Nathan F. Twining (ret.), former chairman of the Joint Chiefs of Staff, is chairman of the board of a newly formed small business investment corporation, the Capital Growth Corp. of America. Dan A. Kimball, president of Aerojet-General Corp., is vice chairman of the advisory board. President and chairman of the executive committee is C. Robert Mathis, senior partner in a Washington, D. C., law firm.

Army-Martin Marietta Pershing tactical ballistic missile will undergo environmental field tests at Ft. Wainwright, Alaska; Yuma, Ariz., and at an unselected tropical site beginning next month. It also will undergo high and low temperature tests at Eglin AFB, Fla. No field launchings will be made. Pershing has had 23 successes and three partial successes in 27 firings from Cape Canaveral, Fla.

Target date for first flight of de Havilland Tridents is Dec. 21. Three Rolls-Royce Spey turbojets have been installed and are undergoing ground testing.

British European Airways last week decided to appeal against a portion of the 22 competitive routes granted to two independent airlines by the Air Transport Licensing Board (AW Dec. 4, p. 41). Airline has until Dec. 27 to file its case with the Minister of Aviation.

Civil Aeronautics Board last week began hearing the investigation of foreign air carrier permits. A CAB witness testified that Argentina, Venezuela, Chile, New Zealand, The Philippines and Austria had imposed capacity restrictions on U. S. carriers.

Airlines Fear Haste on Mach 3 Transport

Accelerated timetable causes concern; industry wants greater voice in early planning stages of development.

By Robert H. Cook

Washington—Federal Aviation Agency's confirmation of an accelerated timetable for development of a supersonic transport last week intensified airline concern that industry's needs may be adversely affected by the government's haste.

The new goals, first revealed by AVIATION WEEK last month (AW Nov. 6, p. 40), were discussed by USAF Col. Lucian S. Rochte, Jr., chairman of a joint FAA-Department of Defense-National Aeronautics and Space Administration supersonic transport committee.

They are the following:

- **Completion of research** projects and selection of contractors by 1963.
- **Prototype construction** by 1964.
- **Initial flight** testing by 1967.
- **Certification and airline** service by 1970.

Col. Rochte told more than 200 airline, manufacturing and foreign government representatives attending a conference on possible airworthiness standards for a supersonic transport that attainment of the desired goals will depend on further financial support from the government as well as hoped-for contributions from the manufacturing industry.

"Vast technical gaps" must yet be filled before a Mach 3 transport can reach the drawing board stage, Col. Rochte said. The most important of these will require extensive research to aid in development of new metals and alloys to solve the heat generation problem of supersonic flight; selection of a new type of powerplant suitable for both subsonic and supersonic flight; solution of the sonic boom problem; development of a variable-sweep wing design, and an ultimate aircraft design with a projected life of up to 50,000 hr. flight time, he said.

Research Proposals

Requests for proposals for research in these areas are being distributed to industry now, Col. Rochte said, and an analysis of current research in the sonic boom area will be available by early spring of next year (AW Apr. 10, p. 32).

Col. Rochte's remarks, coupled with a general discussion on airworthiness standards, triggered strong criticism from airline representatives and the Air Line Pilots Assn.

Airline representatives noted that the organizational makeup of the joint supersonic transport committee places all airline interests in an advisory capacity only, through representatives from United and Trans World Airlines. They expressed concern that the entire program might become a "runaway government project" consummated without sufficient early talks with the airlines.

Asked when the carriers could expect direct participation in the program, Col. Rochte said there is so little information available on several major problem areas that the airlines could not benefit from any direct discussions with the manufacturers now.

"We are deeply aware that our present role in the program is that of a catalytic agent, at this time," Col. Rochte said. He explained that current approach of the committee is a broad one, and said it would be impossible to pinpoint the actual working role of manufacturers or their representation on the committee until initial results are obtained from research studies.

Actual role of both the airlines and manufacturers in the over-all program will "unfold gradually within the next 12 to 24 months," Col. Rochte said. To accelerate the joint committee's work, a new advisory group has been formed with Gen. Orval Cook, retiring president of Aerospace Industries Assn., as chairman.

Consensus of airline and manufacturing representatives was that airworthiness standards for a supersonic transport should not be based too closely on military experience with supersonic aircraft, and should not be considered in any concrete form until actual flight experience is gained with a prototype.

AIA also cautioned against adopting too much military thinking in any final design or in airworthiness standards. It said many of the joint committee's suggested standards appear far higher than standards presently applied to commercial subsonic turbojet aircraft operations, which have enjoyed a high safety record compared to piston engine aircraft operations. The safety and reliability standards necessary in military operations differ from those of a commercial operation and should not be permitted to alter airline needs in any final supersonic design, the association said.

AIA pointed out that Civil Air Regulations usually have been developed gradually on the basis of flight experience, and said that any consideration of airworthiness standards at this time was "premature."

ALPA took the position that the solution of design problems should form the primary basis for final airworthiness standards, and said the safety record of subsonic turbojet transports would not appear as favorable if training accidents, "many of which were traced to design problems," were included. The union urged that airlines be given a greater voice in planning for a Mach 3 design and that any proposed regulations go well beyond any consideration of airworthiness alone.

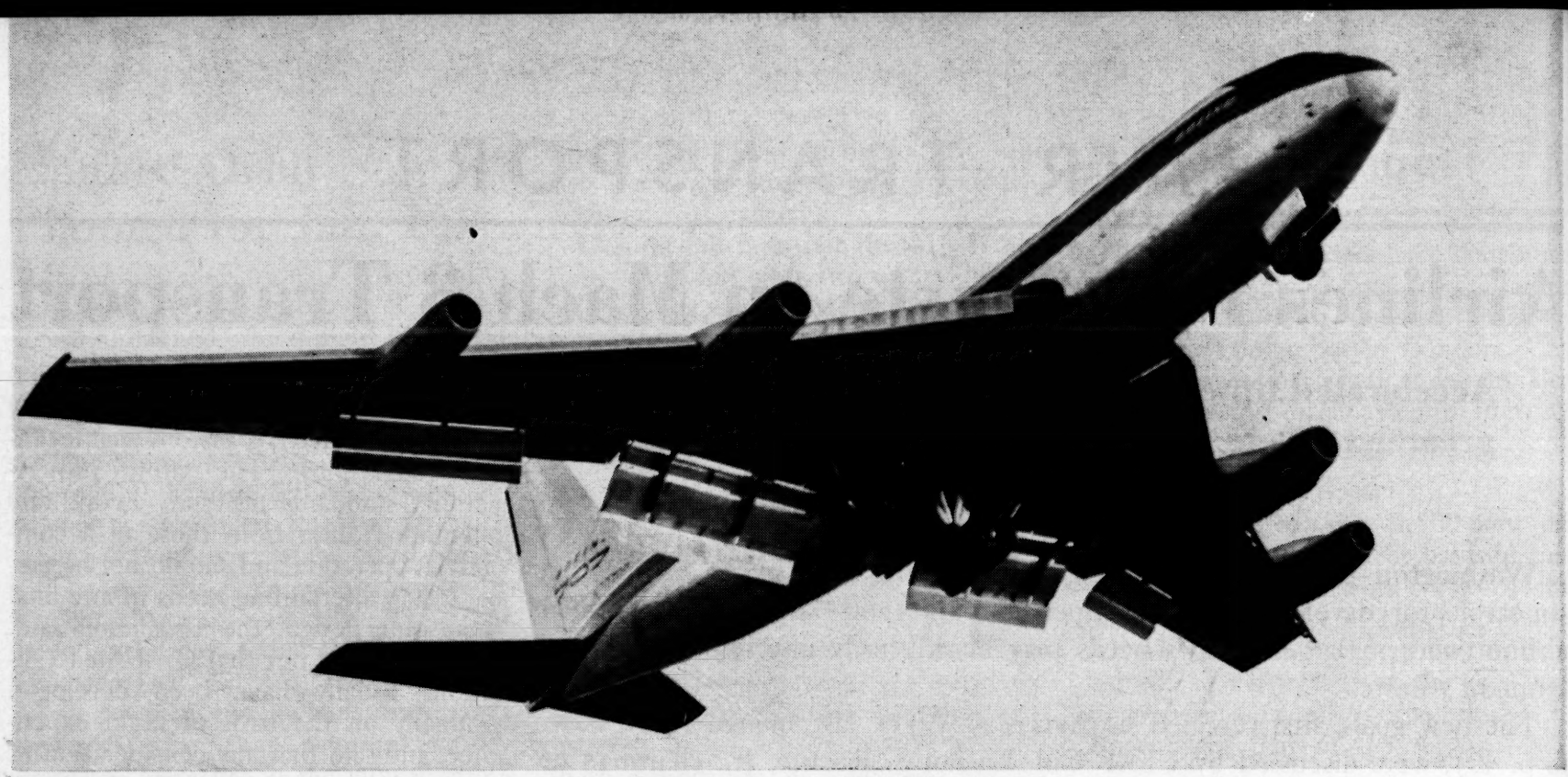
Noise Problem

In particular, ALPA singled out the "noise problem," which currently forces turbojet pilots to execute landing and takeoff procedures different than those recommended in operational manuals in order to reduce complaints of noise over heavily populated areas.

Airlines also were split on the question of whether a Mach 3 transport should be designed in one or more configurations. American favored a single standard design, while United urged competitive designs or a compromise that would permit a single design to adapt itself to the varied seating needs of the different airlines.

Observing that there seemed to be confusion among the airlines as to the intentions of the joint committee, Col. Rochte emphasized that committee plans will remain flexible to absorb any new ideas as the program develops.

He reassured both the airlines and the manufacturers that they will have a direct voice in major phases of the supersonic aircraft development. Final selection of the desired engine cycle for the aircraft probably will be made on the basis of direct consultation between the two groups following engine cycle studies now being made by General Electric Corp. and the Pratt & Whitney Aircraft Division of United Aircraft Corp. under contracts with the Air Force, Col. Rochte said.



HIGH-LIFT DEVICES for the Boeing 727 transport, here being tested on the 707 prototype aircraft, include triple-slotted trailing edge flaps, leading edge flaps and slats. The 727 design has undergone some changes as a result of data from wind tunnel studies. Included are movement of the top engine inlet forward to a position parallel with the other two engines, straightening of the inlet cowl from an aft-slanted position and redesign of the top leading edge of the vertical fin.

Boeing 727 Test Program to Exceed 707s

By Glenn Garrison

New York—Pre-service test program for the Boeing 727 three-engine jet transport will cost about $30 million of company funds and exceed the 707 series testing in scope, company officials said last week.

During the two-year test program, two complete 727 airframes will be tested to destruction. The static test program will be more complete than in previous cases. Previously, the programs involved simple proof loads without destroying the airplane, but loads in the 727 program will be carried to the point of failure. One purpose of the tests will be to trace sequence in which failures occur so that design can be improved and airlines advised of areas to keep under observation.

The production program for the short-to-medium range jet is on schedule, one year after the decision to build it was announced, along with the initial orders. Current backlog is 117 aircraft, with United and Eastern each committed for 40 planes, American for 25 and Lufthansa for 12.

Breakeven sales level still appears to be 200 aircraft, according to J. B. Connelly, Boeing vice president and assistant general manager of the transport division. Boeing is still a long way from breaking even on the 707 program, Connelly said, and the decision to build the 727 was not taken lightly. Jet era experience by manufacturers and operators has been anything but successful financially so far, Connelly said. The basic 727 will sell for about $4.25 to $4.35 million.

There are some good present prospects for sales in both domestic and foreign markets, Connelly reported. However, financing is a problem for potential customers, and another factor is the time element, with the plane scheduled for first deliveries in late 1963. There is little urgency to order an aircraft which could not be delivered until at least 1964.

Connelly said breakeven load factor for the 727 in all-coach configuration is about 45% and for mixed configuration the figure is 50%. The aircraft will carry 70 to 114 passengers.

Contracts totaling $122 million to 500 subcontractors and suppliers have been let during the past year, Connelly said. Boeing is using its Wichita facility for its large parts tooling program and Seattle for its large parts fabrication. About 50% of structural items and 75% of equipment items are covered by contracts already let.

The 727 test program is unique, according to Maynard L. Pennell, transport division director of engineering, in that 4,500 hr. of wind tunnel testing already has been accomplished, and there has been extensive use of the 707 prototype in testing high-lift devices and the rear engine configuration.

One area checked with the single engine mounted toward the rear of the prototype fuselage was possible starvation of the inlet at high nose angles. At altitudes of 35,000-40,000 ft., tests resulted in surging of the third engine, but to a lesser degree than the normal four pod-mounted engines showed.

One reason for more extensive testing of the 727 was the rougher treatment it will get in shorter-haul operations with more landings and takeoffs, Pennell said.

Pennell said Boeing believes rear-engine mounting configuration ideal for a three-engine plane, but not for a four-engine plane. If Boeing were designing another four-engine jet, Pennell said, the engines probably would be mounted in wing pods as was done with 707, not in the rear as in the British Vickers VC.10 four-engine British jet.

The rear-engine mounting entails some disadvantages, Pennell said, including weight and balance and in some aerodynamic areas. On the other hand, there are aerodynamic advantages in other areas.

The 727, which will be landing on relatively short runways, will be equipped with thrust reversers providing about 50% of available thrust, compared to about 35% for the 707, Pennell said. Also, beefing up of the brakes is planned with greater braking areas to help alleviate the problem of multiple landings and short runways. A braking parachute will not be used.

Approach speed is estimated at about 110 kt. for the 727. This compares with about 135 kt. by the book for the 707, although in practice the approach speeds have been considerably higher. With the 720, the comparable approach speed was down to 122 kt., according to Pennell.

Asymmetrical thrust problems have been largely overcome with the 727 configuration, Pennell said, and its rudder is designed almost entirely for cross-wind handling rather than asymmetrical conditions.

The 727 control system is less susceptible to a runaway trim condition, Pennell said. In the 727, more emphasis was given to the elevator control element and less to the stabilizer than in the 707 line. If a runaway situation should develop, he said, there is an automatic feature which cuts off power to the stabilizer when the pilot makes the normal corrective move of the elevator, pulling the nose up or down as the case may be.

Idea of the improvement, Pennell said, was to allow the crew more time to correct a situation.

Controls Mockup

One facet of the test program is construction of a flight controls mockup, near completion, to check both integrity of the system and also the feel of operating it. This will be a full-scale operational rig.

Flight test program is scheduled to begin in the fall of 1962 and will utilize four production aircraft. Certification is scheduled for late 1963.

Northeast Wins Aid; Issue Goes to Court

Washington—Civil Aeronautics Board last week, by a split vote, granted interim approval to Hughes Tool Co.'s plan to give emergency financial aid to Northeast Airlines.

Immediately afterward, National and Eastern airlines petitioned the U. S. Court of Appeals here for a judicial review of a CAB order granting the emergency hearing and requested a stay of the "press release" through which the Board gave its decision.

In the decision, the Board made it clear that its ruling would have no bearing on whether Hughes Tool could take control of Northeast. In the summary hearing in the case, Hughes Tool held that it would extend no financial aid to ailing Northeast unless it was allowed to take control of the airline (AW Dec. 4, p. 39).

Members Chan Gurney and Whitney Gillilland voted to refuse Northeast's request for emergency help. CAB Vice Chairman Robert Murphy, who is participating in negotiations with the Irish on a bilateral agreement with the U. S., was called back to the U. S. to cast the vote that broke the deadlock created by the affirmative votes of Chairman Alan S. Boyd and Member G. Joseph Minetti.

As of late last week, Hughes had made no decision as to whether it would grant the funds Northeast says it needs to survive the rest of the year. Presumably, Hughes lawyers were waiting for the formal CAB decision to interpret the legal intent of the Board's brief "press release" decision.

Both National and Eastern have actively opposed any aid to Northeast throughout the case, which began when Northeast told the Board it must have immediate aid in the form of subsidy or it would be forced to file for receivership. National warned during the hearings that it would take the case into federal courts if the Board ruled in favor of Hughes Tool and suggested that Eastern would probably follow suit.

Doubts Expressed On No-Show Fines

Washington—Possibility that fines as high as $50 against airline no-shows will meet violent objections from travelers is causing serious doubts as to the value of the proposed plan to penalize passengers who fail to use confirmed reservations.

The plan, devised by a committee representing the 11 trunklines, calls for a "reservations service charge" against no-shows of $5 or 50% of the remaining portion of a ticket, whichever is greater, with a maximum of $50. The committee met under a Civil Aeronautics Board order permitting airlines to discuss ways of curtailing no-shows.

The plan allows no-show passengers one escape from the penalty; any passenger presenting written evidence that space was canceled will not be fined.

Air travel card holders will be assessed through billing procedures. Passengers unable to pick up tickets prior to flight time will be required to give their full names and addresses at the time reservations are confirmed so that no-shows may be billed later.

Some airline officials sense that while many passengers are willing to accept such inconveniences as excess baggage charges or the austerity of some coach services without complaint, a growing number is openly objecting to baggage mixups, delayed and canceled flights, misleading flight information and other poor service. A heavy no-show penalty, many in this group feel, will only intensify these complaints, particularly if fines are imposed arbitrarily without consideration of factors that often make it impossible for a passenger to cancel a flight.

In fact, several outspoken passengers have suggested that the airlines, in turn, refund a portion of the fare to passengers who have been inconvenienced by unannounced flight cancellations or delays, or other mishaps that disrupt an itinerary.

The plan, if approved by the CAB, will become effective Mar. 1.

Mobile Lounge Order Protested by Airlines

Washington—Scheduled airlines, backed by a survey conducted by a private consultant, are protesting the purchase of 20 mobile lounges by the Federal Aviation Agency as passenger loading vehicles at the new Dulles International Airport now being constructed to accommodate jet traffic here.

The lounges are 90-passenger vehicles designed to operate between the Dulles terminal building and parked aircraft as a means of eliminating the finger-type concourse, thus reducing the walk for passengers between the main terminal building and loading gates.

The airlines have said earlier that since the lounges are of an experimental nature, only five, rather than 20, should have been purchased initially. Earlier this month, FAA signed a $4.6-million contract for the 20 lounges, despite expressions by some airlines several months ago that the operation, based on tests conducted with a prototype, may not prove to be practical.

The survey, conducted by Aviation Services Co. of Minneapolis, recommended that a finger-concourse with 20 loading positions should be constructed adjacent to the terminal building. It urged that the number of mobile lounges should be held to a minimum until their use had passed the experimental stage.

The report claimed that the annual cost of operating a 25-unit mobile lounge system would be approximately $1.1 million, compared with the $682,000 annual cost of maintaining, operating and amortizing the finger system. It noted that the finger plan would accommodate airline traffic requirements through 1968 and would provide greater flexibility and capacity during peak-hour operations.

The report estimated that 25 mobile units, assuming two to be out of service for maintenance, could handle about 18 aircraft departures and four arrivals per hour. The survey concluded that, since a substantial investment had already been made in the development of the lounge, the system should not be dropped but should be used experimentally.

A dual system, employing both the finger-concourse and the lounge unit, would not fully commit the FAA to a "system which probably is impractical for a major portion of the present domestic traffic at Washington," the report said. It suggested that the lounge system be used for the handling of international traffic under a dual operation.

TWA Caravelle Order

Trans World Airlines is facing a decision by mid-December on whether to drop its order for 20 Sud Caravelle 10As because of discouraging prospects for sale of common stock as partial financing of the order.

TWA's contract with Sud in September (AW Sept. 11, p. 41), allowed TWA until November to investigate the common stock market outlook and this deadline was extended a month. Airline stock prices—including TWA—have been working downward since and TWA stock now is selling at approximately $12 a share, $6 below per share book value.

Long-term financing, probably on a lease basis, by Sud for airframes and General Electric for CJ805-23C turbofan powerplants is also part of the financing program. Delivery dates have slipped about 30 days as a result of the delay, but Sud will soon be faced with decisions on keeping the production line open. Results of TWA's fare increase request (see column two) may play a key role in the future of the Caravelle order.

Navigators and TWA Agree on Contract

Washington—Trans World Airlines signed a three-year contract with its navigators last week, ending the threat of a strike by the Transport Workers Union over the airline's proposed use of Doppler navigational aid equipment.

Meanwhile, the Air Line Pilots Assn. awaited the results of a Civil Aeronautics Board hearing requested by the union on the pilot strike at Southern Airways which began 17 months ago.

Terms of the TWA navigators' contract provide for an immediate 5%, across-the-board pay raise for the 55 TWU members, plus a stipulation that scheduled tests of Doppler equipment will not be conducted for a period of seven months. A company decision to resume the tests will require pilot approval and further four-month delay.

Should the tests then be resumed, 18 of the navigators would be placed in a pool for piston aircraft operations for the remainder of the contract life. Balance of the navigators would be offered severance pay up to $25,000, plus $400 per month for three years, union said.

ALPA claimed that Southern demanded striking pilots forfeit seniority rights and submit to company discipline as a condition to being re-employed.

CAB Examiner William Cusick earlier ruled that the union failed to prove its case, and recommended that the Board reject ALPA's proposal that Southern be forced to drop its demands under threat of losing its subsidy.

Rule Would Let CAB Start Route Action

Washington—Civil Aeronautics Board is studying a proposed rule that would allow it to initiate foreign and domestic route proceedings as part of long-range policy planning.

At present, CAB said, the initiative for starting a route proceeding is left to the air carrier or civic parties whose interests may not coincide with the public interest.

The proposed rule, if adopted, will provide an additional method for beginning route proceedings. A CAB-initiated route proceeding would take the form of a "show cause" order or an order of investigation coupled with statement of tentative Board position. Thus, the scope of the case would be defined at the outset, avoiding the volume of litigation needed under the current practice.

Parties having a substantial interest in the proceeding would be given a chance to object by filing a motion within the time limit set by the order. Answers to motions could be filed within seven days and from that point on, the proceeding would be handled conventionally.

Northeast, Eastern Trade Fare Protests

Washington—Eastern Air Lines has protested the proposed tariff for Northeast Airlines' "Local Sunliner Bus," a service similar to Eastern's air bus service, scheduled to go into effect between Boston-Tampa-Miami with DC-6B equipment next month.

Eastern claims the tariff—comparable to that of its air bus—is too much of a fare reduction for the low-density, 76 passenger two-abreast seating Northeast plans to use on its DC-6B.

Northeast, in turn, has protested the tariff for Eastern's Boston-Tampa-Miami air bus service due to go into effect Dec. 15 with 90-95 seat Constellation and DC-7B equipment as being too low to warrant the 13% fare reduction from Eastern's day coach service.

TWA Seeks Higher Coach, Piston Fares

Washington—Trans World Airlines last week asked for fare increases on air coach travel to narrow the margin between first-class and coach rates and an increase in free baggage allowance for first-class passengers.

In a letter to the Civil Aeronautics Board, TWA President Charles C. Tillinghast, Jr., recommended a $1 increase on all tickets, plus a 5% increase on all coach fares and a 5% increase on first-class fares for non-jet flights of less than 1,200 mi. The new rates would raise revenues by $11 million, he said.

The need for increased revenues precludes any reduction of first-class fares as a means of narrowing the gap between first-class and coach rates, he said. In effect, Tillinghast is seeking more service for the higher price the first-class passenger pays and more austerity for the coach passenger.

He said he intends to drop the family-plan fare discount and supports recent industry trend toward eliminating free meals for coach passengers.

BEA-Sabena Vertol Discussions Advance

London—Negotiations for the purchase of three Boeing-Vertol 107 turbine helicopters for the British European Airways-Sabena service connecting London, Brussels and Paris were in advanced stages here last week.

Minister of Aviation Peter Thorneycroft, who said he favored purchase of the three helicopters, said he was discussing future operational plans with the airlines before giving final approval.

He stressed that the Vertols will be interim aircraft, pending development and production contract for the Westland Rotodyne VTOL transport. Ministry also is negotiating a Rotodyne order for the Royal Air Force, which will have an acute bearing on the VTOL's civil future.

Vertols, if purchase is approved, could be built under license by Westland (AW Oct. 9, p. 34).

Lufthansa 720B Crash Study Impeded

Frankfurt, Germany—Investigation of the recent crash of a Lufthansa German Airlines Boeing 720B is being hampered, officials here said last week, by the extensive damage to the aircraft on impact and from the subsequent explosion. The aircraft was on a training flight.

The pilot last reported his position at 6,000 ft. and said he was climbing for altitude on a flight to Cologne. The crash occurred about six minutes after takeoff and from one to three minutes after the pilot's report. The three crew members aboard—pilot, check pilot and flight engineer, were killed in the crash.

The aircraft, fourth and latest 720B to be delivered in Lufthansa's order of eight, apparently struck the ground while in a 60- to 70-deg. dive. Officials said attempts to isolate the cause of the accident may be difficult because of the damage, and the fact that pieces of the plane were imbedded in the plowed soil where the aircraft struck.

QANTAS will be operating a total of 11 Boeing 707-138B turbofan transports on its system by January. To meet Qantas requirements of limited payload and long-range capability, Boeing reduced fuselage length of the standard 707-120 by 10 ft. and redesignated the modified aircraft as the 707-138 (AW July 31, p. 39).

Civil Aviation in Australia and New Zealand–Part III:

Geography Dictates Qantas' Fleet Needs

By L. L. Doty

Sydney–Australia's insular position and its almost total dependence on international trade for economic growth have set the pattern for the route structure and aircraft performance requirements of Qantas Empire Airways, the nation's international civil air arm.

Development of Australia's air routes and selection of aircraft to fly them economically and efficiently has been a formidable task. The country is far removed from major air routes, it is still not a heavy passenger traffic-producing area and it is remote from important sources of tourist travel.

In the past, Qantas has given most attention to its Kangaroo route to Great Britain and the transpacific Southern Cross route to the U. S. because they have best served Australia's principal commercial market interests. In the immediate future, attention will be focused on the Far East and Southeast Asia markets.

Australia's trade interest in the Far East is growing rapidly. In the third quarter of this year, Australia's exports to Japan exceeded both those to the United Kingdom and the U. S. Red China was the country's fourth best customer, only slightly behind third-place U. S. in dollar volume. Fear of the effect of England's proposed participation in the European common market may have on Australia could add more impetus to trade activities in the Far East.

In the not-to-distant future, expansion is planned for routes to South America, the Antarctica and Africa, where a token service is already in operation. The African service to Johannesburg has been conducted at a loss since 1952, but in line with Australia's unwritten policy of maintaining air routes parallel to trade routes, it is justified as a communications link with the nation's commercial interests in South Africa.

Although South Africa is no longer a part of the British Commonwealth, Qantas operates the Indian Ocean route under a pooling agreement with South African Airways. Qantas is showing strong interest in the expansion of the pooling system on other route segments. Under a tripartite agreement with British Overseas Airways Corp., Air-India International Corp. and Qantas, a pooling operation is conducted over 143,700 mi. of routes covering services from London via India to Sydney including Hong Kong and Tokyo, and some transatlantic services.

Route Expansion

Route expansion plans for the distant future are also ambitious. Qantas has studied the possibilities of laying out a South Polar route from Australia to South America and South Africa to take advantage of the mileage saving of a great circle route.

In addition, studies have been made of an around-the-world route within the southern hemisphere via South America and Capetown. A requisite would be an improved airport at Easter Island.

Hub of the entire system will continue to be its presently operated around-the-world route which gives Qantas entry into the leading markets of the world. At the present time, Australia has bilateral air transport agreements with 28 other governments.

To give the airline the aircraft performance required on these routes–high-speed, long-range and moderately light passenger capacity–Boeing built the 707-138 to Qantas' specifications. With a fuselage length 10 ft. less than the standard 707-120, takeoff weight is reduced by 10,000-lb., permitting operations on limited runway lengths typical of airports on Qantas routes.

The smaller fuselage, accommodating 90 seats in a combination first-class and tourist configuration, provides capacity keyed to a low-density traffic demand, thus helping to sustain load factors. Qantas originally ordered seven 707-138 transports, which are now being converted from Pratt & Whitney JT3C turbojet power to P&W JT3D-1 turbofan engines.

Meanwhile, it purchased three 707-138B turbofan transports and leased another, all of which have been delivered, so that in January, when the conversion of the original seven will be completed, Qantas will have a fleet of 11 707-138B turbofans.

Length of the Boeing 707-138 fuselage is 128 ft. 10 in. Gross takeoff weight is 257,000-lb., and range is 4,000 mi. with a 30,000-lb. payload. Cruising speed is about Mach .85.

Performance characteristics and fuse-

New TWA Los Angeles terminal...and more to come!

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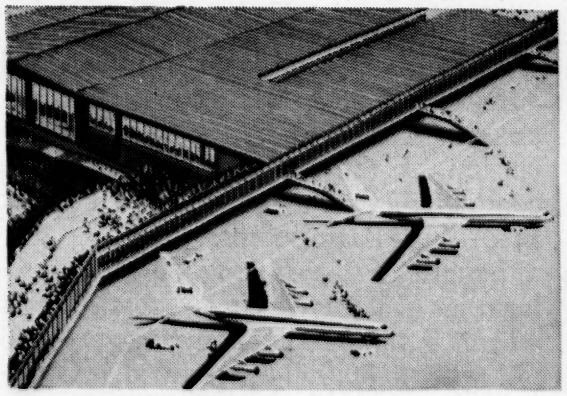
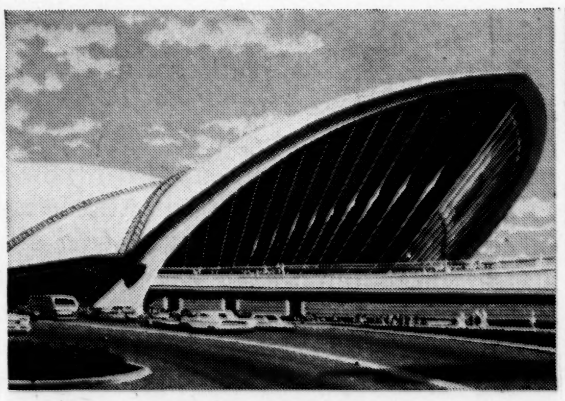
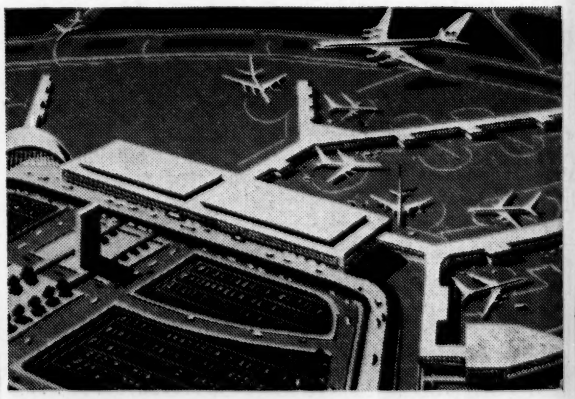


ROME—new TWA facilities serving Rome, opened this year in the new terminal at the Leonardo da Vinci Airport, Fiumicino.



NEW YORK—this TWA terminal soon to open at the International Airport reflects the jet age in soaring concrete.



CHICAGO—coming soon TWA's new, jet-age terminal with many new features of O'Hare International Airport.

lage size compare favorably with the 720 version of the Boeing 707. However, the slightly shorter range and lower gross weight of the 720 were factors in the final decision for the 707-138.

The turbofan aircraft now operates on Qantas' main around-the-world routes. Last month, regular Boeing service was introduced on the carrier's routes to the Philippines, Hong Kong and Japan. Shortly, it will be operated on the Sydney-Noumea route, and, after the Auckland airport has been enlarged, it will be introduced on the route across the Tasman Sea to New Zealand.

In addition to the 11 Boeing 707-138Bs, Qantas operates four Lockheed turboprop Electras, four Lockheed 1049G Constellations, four Lockheed 1049H all-cargo transports and two Douglas DC-4s.

For the immediate future, Qantas foresees no need to supplement its fleet of 707-138Bs with another model aircraft, and expects to increase the Boeing fleet to 20 during the next 10 years. Engineers believe that the larger jet aircraft to be made available soon—such as the Boeing 707-320B or the Vickers Super VC.10—are too large for the traffic volume Qantas is handling or will handle for several years.

Long Range Required

Qantas is not interested in the short- and medium-range jets now available because most of its routes are long. Although the standard VC.10, which will be ready for delivery in 1964, compares favorably with the 707-138B with respect to payload, range and speed, and has the added advantage of a shorter takeoff capability, it is substantially heavier than the 707-138B and thus, Qantas believes, would be more costly to operate.

Simply stated, Qantas' equipment philosophy is based on the theory that higher schedule frequency with less capacity is more profitable than low schedule frequency with high capacity.

Qantas hopes to have its fleet fully standardized with the Boeing 707-138B within the next three years. In that time, if airport facilities throughout the carrier's system have been modernized for jet service, the Electra fleet will be phased out.

For Qantas, the supersonic transport is the ultimate aircraft for international service. Unlike much of the industry, Qantas deplores the foot-dragging in the initial stages of supersonic transport development. The airline is giving enthusiastic support to the airplane, although it recognizes the many problems which will accompany the airplane's appearance.

The long-range equipment program of Qantas is geared to the introduction of the supersonic transport. It is convinced there will be no satisfactory interim airplane which can replace the Boeing 707-138B before the supersonic transport comes off the production lines which, it hopes, will be in the next decade.

Substantial Time Saving

The reason for this eagerness is based again on Australia's isolated geographic position. The supersonic transport will cut flying time to London and New York by almost two-thirds. For example, total elapsed flying time from Sydney to London via the Middle East will be reduced from 31 hr. 40 min. in a Boeing 707-138B to 12 hr. 25 min. in a Mach 3 transport.

The airline believes that a Mach 3 transport with a payload and range performance about on par with the 707-138 would be ideally suited to its routes and would provide Australia with a transportation link that will bring it closer to most of its world-wide markets.

Qantas is an abbreviation of the carrier's original name—Queensland and Northern Territory Aerial Services. It was formed in 1920 to operate within Australia. It began overseas operations in 1934 in conjunction with Imperial Airways on the Brisbane-Singapore route.

It is now a purely international airline. Last year, the Commonwealth government transferred all Qantas services between Australia and New Guinea and those within New Guinea and Papua to the two domestic airlines (AW Dec. 4, p. 47). Qantas' subsidiary holdings include a 32% interest in Malayan Airways, with a similar proportion owned by BOAC and the balance by the governments of Malaya, Singapore, North Borneo, Sarawak and the State of Brunei.

Qantas also holds a one-third interest together with TEAL and BOAC in Fiji Airways (AW Nov. 13, p. 47). In April, New Zealand purchased Australia's 50% share in TEAL (Tasman Empire Airways, Ltd.) to make that carrier a totally-owned New Zealand company. Subsequently, the two governments signed a bilateral air transport agreement giving Qantas traffic rights to fly to and through Auckland, Wellington and Christchurch. The agreement breaks a monopoly TEAL has held on the Tasman Sea route for 20 years, during which it operated in accident-free scheduled service.

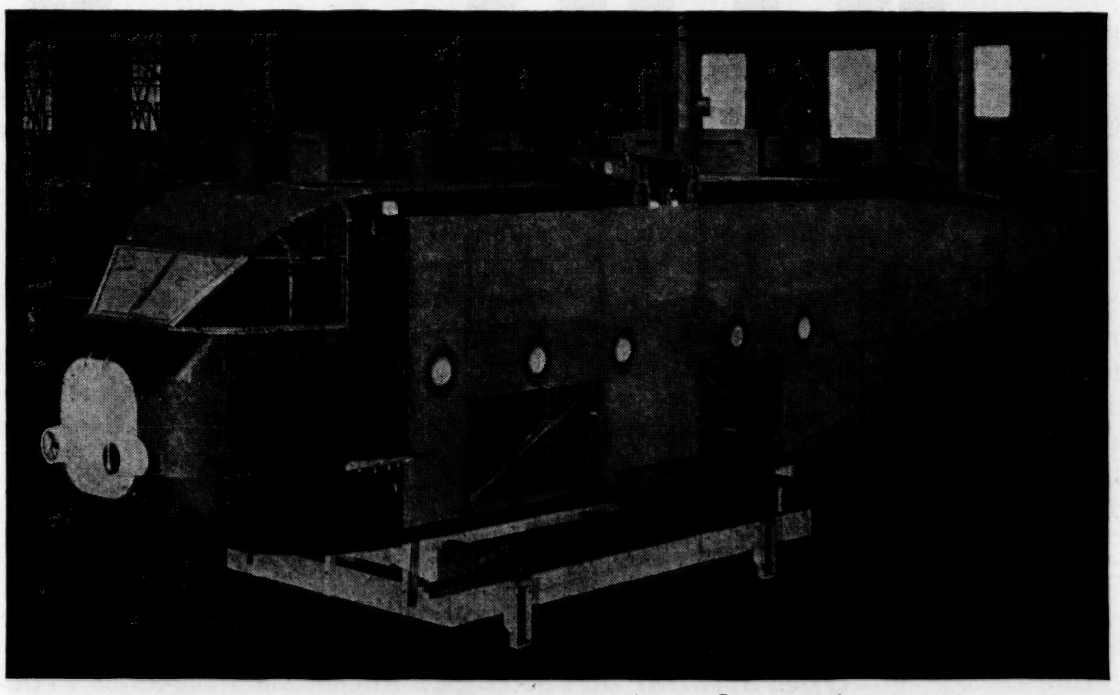
Worried by U.S. Policy

The Australian government has been a hard bargainer in bilateral agreement negotiations with other governments, but is now showing increasing concern over the steady increase in the protectionist attitude being adopted by the U. S. and a number of other nations.

This recent change from the freedom-of-the-air policies of the past is attributed by the Australian government to the sudden surge of seat capacity resulting from the introduction of high-payload jet transports. The Australian government is particularly critical of international airlines that have allowed the excessive capacity problem to reach a point that prevents economic utilization of jet transports.

Australians are not concerned they will lose any of the traffic rights they now hold, especially on the lucrative long-haul routes to England and the U. S. But they recognize that Qantas, as well as the other airlines of the world, will face even more difficult trading conditions in the next year or so.

Qantas fought hard several years ago to win cabotage rights in the U. S.—



Skyvan Fuselage Nears Completion

Main fuselage section of the Short Skyvan I transport (AW Nov. 6, p. 71) is nearing completion at the Belfast, Ireland, production facility of Short Brothers & Harland. Airplane is scheduled to fly next spring. Wing sections are well advanced.

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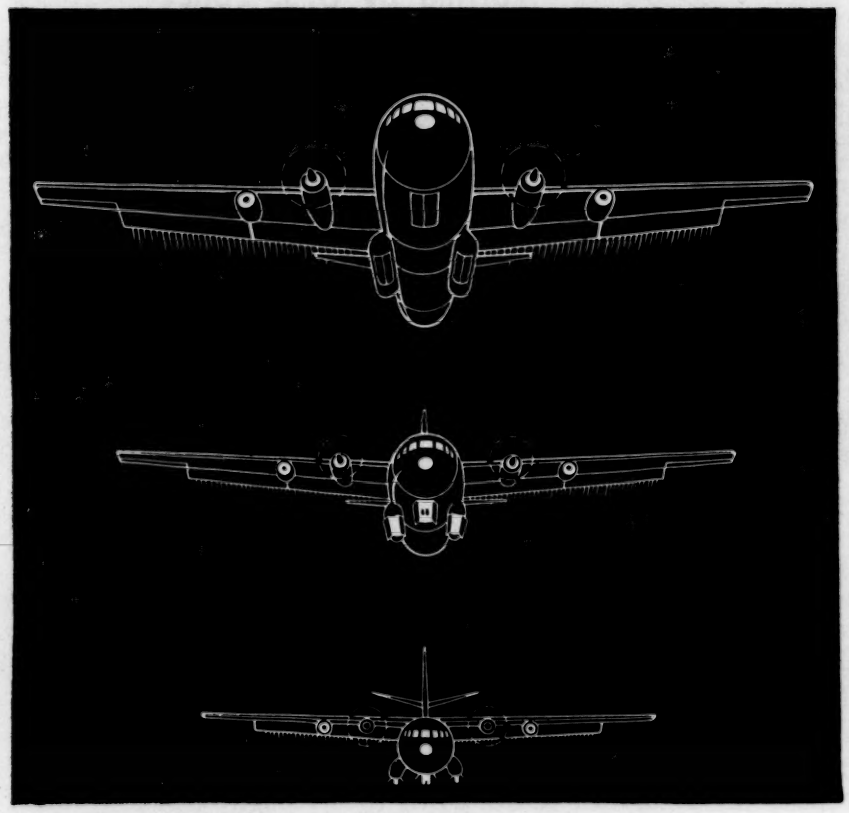

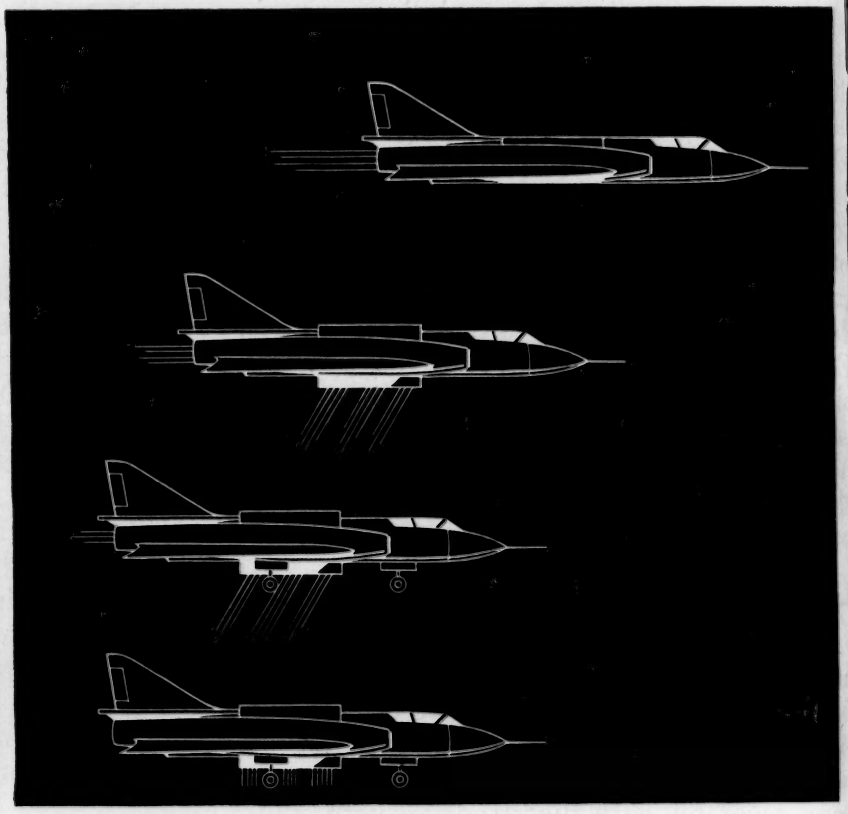

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Experience Since 1941 Rolls-Royce has pioneered work on STOL and VTOL powerplants; the company's experience in this field is unrivalled. Techniques have been proved by a wide range of ground and flight tests including those with the "Flying Bedstead" and the Short SC.1 research aircraft.

Wide choice Rolls-Royce can offer a very wide range of jet-lift and propulsion composite powerplants suitable for all types of subsonic and supersonic STOL and VTOL aircraft. Lightweight performance boost can be provided for STOL aircraft either by direct jet thrust or by flap-blowing for high lift.

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Red China to Buy Viscounts

London—Red China last week contracted to buy Vickers Viscount turboprop transports for its civil aviation administration, confirming Aviation Week reports on the transaction (AW Oct. 9, p. 38 and Nov. 27, p. 17).

Because of Peking pressure, British Aircraft Corp. declined to comment on the sale, but the order is for six Viscounts and is worth about $9 million. Delivery will be by the end of 1962, with an option on another six still under consideration.

Deal is interpreted as complete Red Chinese disenchantment with Soviet equipment on the national airline routes, such as the Il-18, Il-14 and Il-12. Reasons for this disenchantment apparently include high operating costs and low overhaul life of the engines.

Rolls-Royce team still is in Peking, working out final details on spares delivery and after-sales liaison for the Dart turboprop which powers the Viscount. In all, joint Vickers-Armstrongs and Rolls' talks with the Red Chinese have been in progress since January. The talks reached a firm stage during the annual Farnborough air display.

British Aircraft Corp. denied that Vickers VC.10 four-jet transport and BAC 111 twin jet medium-range carrier are currently under negotiation. However, a Red Chinese technical team spent considerable time examining the two jets during the Farnborough show.

In addition to its domestic network, the state airline flies to Ulan-Bator, Tibet, North Korea, Irkutsk, Vietnam and Hanoi.

Airline also is interested in extending operations to Japan, Indonesia, the Middle East and Ghana.

To date, 429 Viscounts have been sold to the world market. Although no aircraft as such are on the Hurn production line, Vickers-Armstrongs has been building components sections, to keep its shop lead time high.

rights to carry international passengers between San Francisco and New York on flights operating between Sydney and London. Qantas lost this bid but only after a bitter fight.

Major Goal

Qantas' immediate major goal is to obtain rights to operate into Tahiti. This is being bitterly opposed by Pan American and South Pacific Airways, but Qantas holds that a Tahiti stop is included in the U. S.-Australia bilateral agreement. The U. S. State Department has upheld this interpretation.

Final decision on this issue will be made by the Civil Aeronautics Board, which must issue a foreign air carrier permit to Qantas before Tahiti can be included in schedules. One Qantas official told AVIATION WEEK that failure to win traffic rights in Tahiti could result in a "severe strain in Australian relationship with the Americans."

Passengers Diverted

Qantas admits that TAI, the French airline which won traffic rights between Sydney to Los Angeles via Tahiti in separate agreements with the U. S. and Australia, is diverting transpacific passengers from it due to the Tahiti stop (AW Nov. 6, p. 43). As a consequence, there is much criticism of the Australian-French bilateral agreement—which has not yet been ratified—as being overly generous to the French.

Negotiations between the French and Australia were often bitter, particularly during the time when, under a provisional agreement, TAI held traffic rights through Brisbane and Darwin on its Pacific route and Qantas was granted rights to Noumea, French New Caledonia.

TAI wanted rights through Sydney, because of its traffic potential, and renounced the provisional agreement. The present agreement went into effect last year after Qantas was forced to suspend operations into Noumea for about three months.

Jet Competition

Qantas began this year to feel the pinch of heavy jet competition on routes. In addition, the world-wide traffic depression, which has caused a profit-squeeze within the industry, was severely felt by Qantas. Net profit for the year ending Mar. 31 was substantially less than during the previous period. Rate of return on average paid-up capital for the latest 12-month period was 3.7%, compared with 7.16% in the previous period.

Although Qantas has rigidly held to the principle of limited capacity, available seat miles outstripped passenger volume to drop load factors from 56% in 1959 to 53% last year. Revenues climbed 19% due to a 44% increase in tourist and economy-class passengers. First-class traffic declined 1%.

The airline is pinning its hopes for further revenue increases on the air freight field and feels there is a great future in this area for its particular type of operation. During the 12 months ended Mar. 31, the airline handled 28 million ton miles of air cargo, a 48% increase over the previous year.

Cargo capacity now averages 70 tons per week, majority of which is provided by the four Lockheed 1049H all-cargo transports. Currently, an intense cargo sales campaign is being conducted in a move to expand the use of air by Australian exporters.

(This is the third of four articles examining the civil aviation situation in Australia and New Zealand.)

U.S. Talks With Irish Are Near Deadlock

Dublin—Negotiations between Ireland and the U. S. drew close to a stalemate last week with the Irish standing firm in their position that U. S. flag carriers should serve Shannon rather than Dublin on transatlantic flights.

U. S. is seeking landing rights at Dublin with beyond rights from New York to London and European ports of entry (AW Dec. 4, p. 50). TWA, which operates a peak-season transatlantic service terminating at Shannon, claims it is unable to compete effectively with Irish Airlines which flies directly to Dublin from New York, Boston and Chicago.

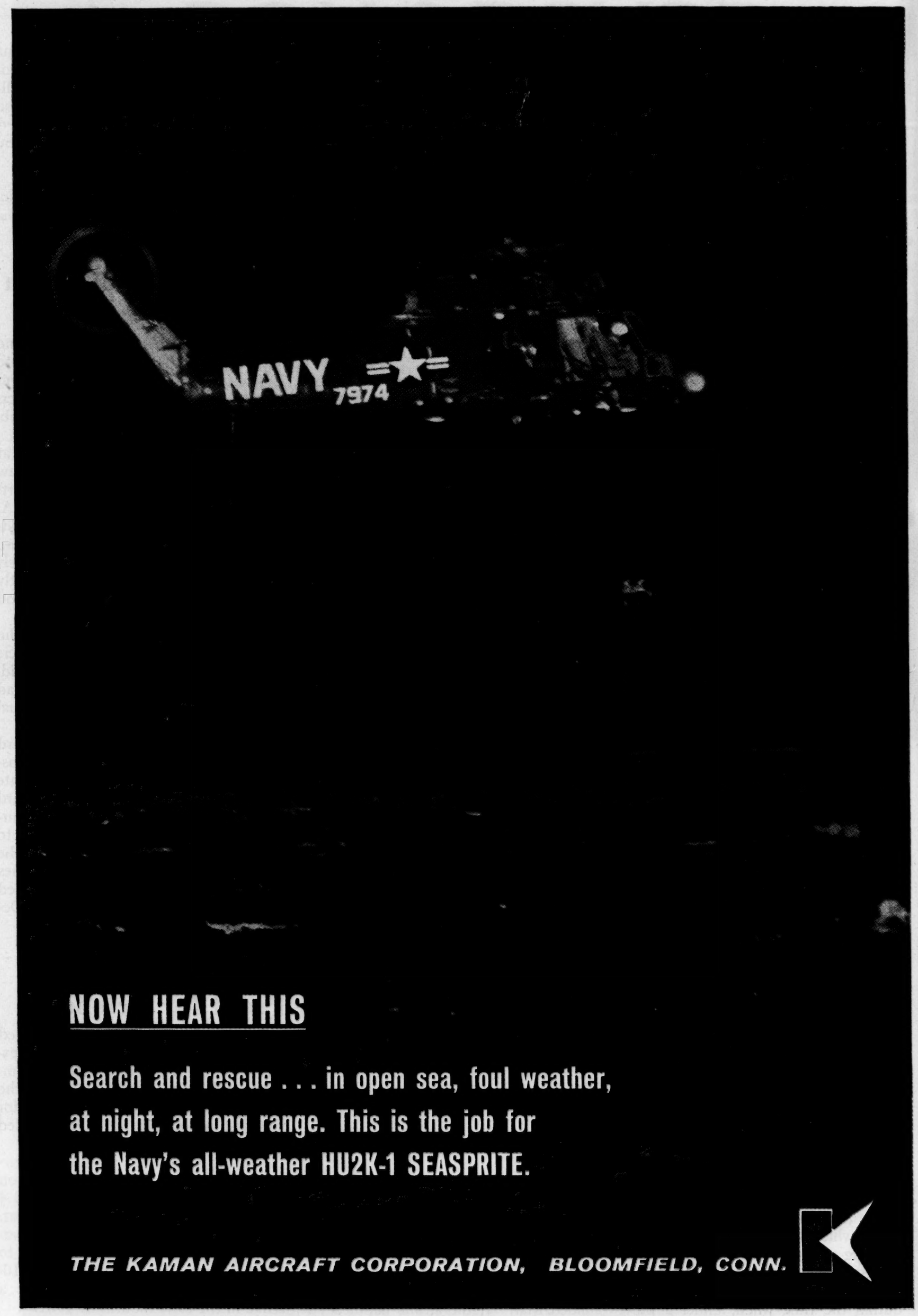
The Irish hold that Shannon is the natural tourist stop for U. S. flag carriers and is rigidly opposing the U. S. bid. As of late last week the Irish stand had forced the discussions into a virtual deadlock.

U. S. delegation is headed by Edward Bolster, director of the Office of Transport and Communications of the State Department. Civil Aeronautics Board is represented by Member Robert Murphy, who left the talks temporarily to return to the U. S. to participate in the voting in the Northeast Airlines-Hughes Tool Co. case. Irish delegation is led by Dr. T. J. Beere, Secretary of the Department of Transport and Power.

Northwest Reports Profit for October

Northwest Airlines last week reported a net profit, after taxes and interest expense, of $79,434 for October compared with a net loss of $272,591 in the same period last year. Net earnings for the first 10 months of 1961 totaled $3.5 million.

The airline showed a marked reduction in expenses; from $102.1 million for the first 10 months of 1960 to $81.4 million in the same period this year. Revenues declined during the comparable periods from $104.8 million to $90.8 million. The airline said the 10-month figures reflect the effect of a strike in the early months of 1961.



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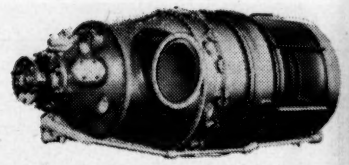
THE KAMAN AIRCRAFT CORPORATION, BLOOMFIELD, CONN.

Airline Income and Expenses—September, 1961

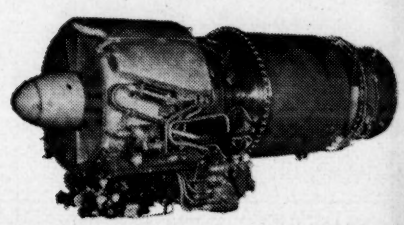
	Passenger Revenue	U.S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expense	Net Income Before Taxes
DOMESTIC TRUNKS								
American	$31,967,819	$ 694,096	$392,673	$2,397,095	$ ----	$35,887,121	$34,516,791	$1,370,330
Braniff	5,712,682	162,045	76,050	262,996	177,754	6,461,396	6,104,279	205,579
Continental	4,696,000	98,000	47,000	147,000	20,000	5,099,000	4,654,000	217,000
Delta	10,664,000	233,000	135,000	434,000	----	11,684,000	11,527,000	– 38,000
Eastern	17,988,553	449,049	----	1,059,352[1]	----	19,673,388	23,424,008	-3,870,663
National	5,242,475	139,692	35,103	348,009	100,940	6,003,031	6,419,132	-609,596
Northeast	3,425,805	64,445	43,031	86,825	----	3,701,937	4,573,820	–1,075,436
Northwest	6,579,764	209,720	----	530,096[1]	20,337	7,307,803	6,843,401	322,805
Trans World	22,604,991	502,514	----	1,625,682[1]	233,459	25,168,713	25,081,483	-2,157,514
United	39,733,826	1,252,044	----	2,995,615[1]	214,463	44,335,882	43,922,936	-393,166
Western	5,365,392	106,617	----	205,342[1]	65,607	5,769,752	5,353,433	245,165
INTERNATIONAL								
American	472,824	6,560	396	63,530	----	571,892	604,134	-32,242
Braniff	740,420	32,753	----	77,059	613,775	1,508,658	1,340,875	139,647
Caribbean Atlantic	259,859	2,715	----	17,054[1]	6,680	290,687	293,857	-2,594
Delta	133,000	----	----	2,000	----	141,000	209,000	-68,000
Eastern	2,308,900	50,253	----	129,506[1]	----	2,489,030	2,468,253	-21,212
Mackey	83,838	----	475	2,646	----	98,485	155,032	-55,817
Northwest	2,512,824	675,905	----	350,837[1]	163,876	3,849,020	2,727,456	1,011,717
Pan American Combined	32,197,000	2,590,000	----	4,247,000[1]	4,372,000	44,126,000	39,295,000	4,237,000
Alaska	384,000	18,000	----	61,000[1]	----	495,000	445,000	88,000
Atlantic	16,487,000	1,234,000	----	1,752,000[1]	2,406,000	22,123,000	19,903,000	2,516,000
Latin America	7,306,000	224,000	----	1,330,000[1]	380,000	9,515,000	9,602,000	-82,000
Pacific	8,020,000	1,114,000	----	1,104,000[1]	1,586,000	12,006,000	9,346,000	2,708,000
Panagra	1,368,000	66,000	----	249,000	----	1,956,000	1,789,000	133,000
South Pacific	38,710	194	----	2,588[1]	----	41,675	88,891	-52,757
Trans World	7,272,835	677,543	----	706,164[1]	229,186	9,081,988	7,898,676	-1,065,713
United	2,197,348	91,109	----	94,981[1]	----	2,404,549	1,904,168	450,641
Western	521,578	1,733	----	10,773[1]	----	536,466	425,368	101,066
LOCAL SERVICE								
Allegheny	1,142,919	24,892	28,848	42,551	----	1,779,133	1,563,435	166,631
Bonanza	456,344	3,842	3,588	7,314	----	758,763	688,679	52,870
Central	332,296	13,739	1,929	19,164	5,869	499,498	739,812	-186,161
Frontier	592,300	13,239	5,951	29,291	7,587	1,249,394	1,256,514	2,609[2]
Lake Central	504,565	12,026	13,151	14,871	8,096	904,725	918,738	-34,970[2]
Mohawk	1,232,599	15,892	19,667	31,968	33,443	1,731,682	1,628,194	30,321[2]
North Central	1,355,569	33,480	29,800	48,461	----	2,147,282	2,064,417	65,883
Ozark	674,840	15,704	18,887	34,475	6,977	1,116,712	1,090,882	14,556
Pacific	561,307	12,776	6,781	10,261	2,753	923,471	851,044	40,808
Piedmont	747,191	11,611	10,942	17,260	----	1,208,362	1,064,642	143,720[2]
Southern	486,948	16,111	9,632	20,383	13,823	894,061	833,421	48,774
Trans-Texas	429,671	12,200	5,827	20,603	14,016	838,046	823,588	9,050
West Coast	572,885	9,184	3,115	14,970	4,780	1,034,661	906,716	103,032
HAWAIIAN LINES								
Aloha	416,762	2,380	----	4,923	----	438,472	438,472	664[2]
Hawaiian	555,346	3,407	----	78,110	----	649,051	650,620	-23,001[2]
CARGO LINES								
Aerovias Sud Americana	----	----	----	53,494	88,803[3]	149,789	181,663	-31,874[2]
Flying Tiger	----	4,056	----	897,757	1,803,930	2,706,870	3,014,170	-490,776
Seaboard World	----	307,421	----	671,941	894,617[4]	1,918,179	2,349,215	-525,026[2]
HELICOPTER LINES								
Chicago Helicopter	121,876	131,514	----	----	----	253,534	274,917	-21,627
Los Angeles Airways	18,243	10,534	14,039[5]	----	----	134,167	129,331	5,852
New York Airways	100,822	3,515	2,523	3,735	----	309,718	336,487	-28,495
ALASKA LINES								
Alaska Airlines	331,273	51,003	811	61,828	194,672	834,973	886,264	-66,414
Alaska Coastal	100,741	10,762	----	11,388	3,905	179,715	182,446	-4,704[2]
Cordova	20,253	11,265	----	15,590	56,289	132,412	127,737	3,663
Ellis	68,800	4,500	----	7,000[1]	3,600	115,000	120,000	-6,000[2]
Kodiak	18,826	905	----	2,432	6,578	31,279	34,866	-2,947[2]
Northern Consolidated	96,567	64,969	----	53,458	----	322,686	336,275	-12,578[2]
Pacific Northern	734,387	89,137	3,952	122,542	666	1,077,930	964,054	11,328
Reeve Aleutian	159,782	47,763	----	48,257[5]	34,211	298,457	213,215	93,361
Western Alaska	5,056	46,261	----	853[3]	4,842	57,423	23,056	34,060[2]
Wein Alaska	108,748	54,003	----	46,409	78,209	431,859	425,820	6,038

[1] Property: express, excess baggage and freight [2] Net profit or loss [3] Military contract [4] Passenger and freight charter
[5] Includes excess baggage Figures for Trans Caribbean, Riddle, Slich and Avalon were not available.

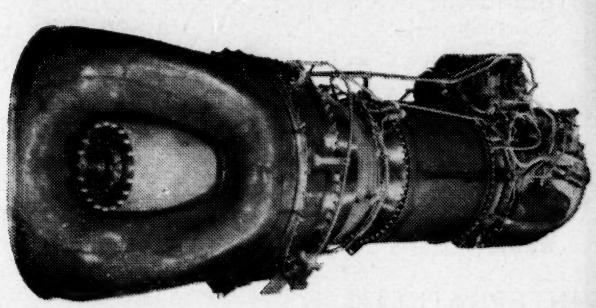
Power



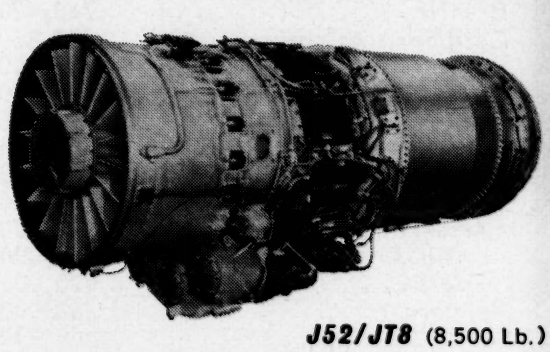
PT6 (500 Shaft HP)



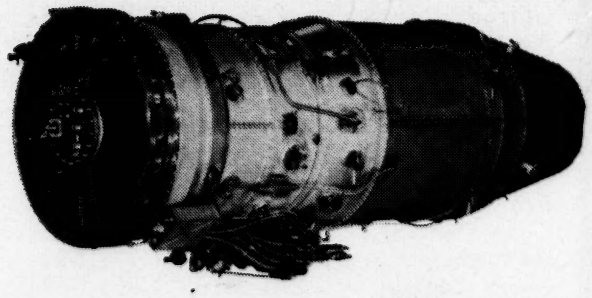
J60/JT12 SERIES (3,000-3,300 Lb.)



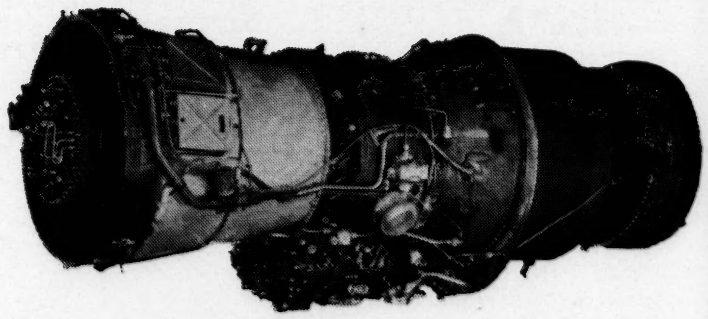
JFTD-12 (4,050 Shaft HP)



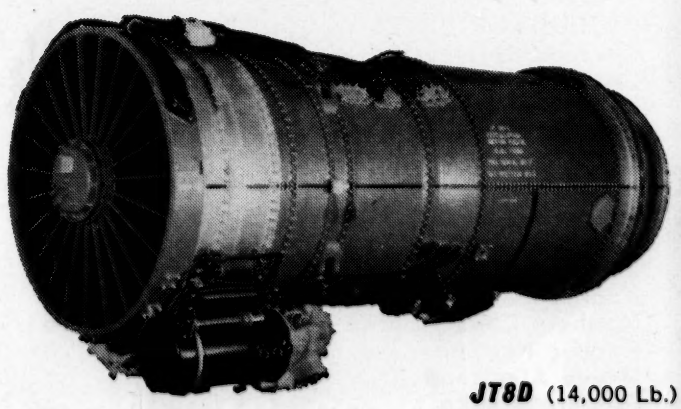
J52/JT8 (8,500 Lb.)



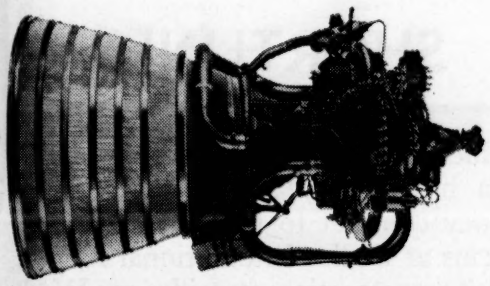
JTF10 (10,000 Lb.)



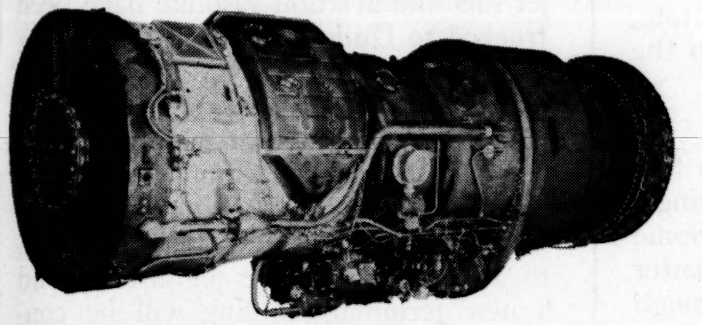
J57/JT3C SERIES (12,000-13,500 Lb.)



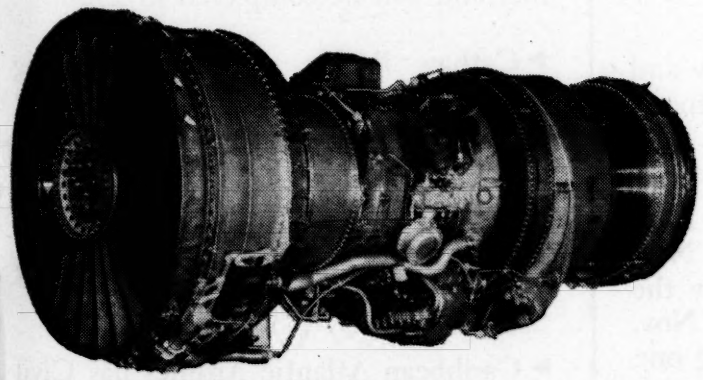
JT8D (14,000 Lb.)



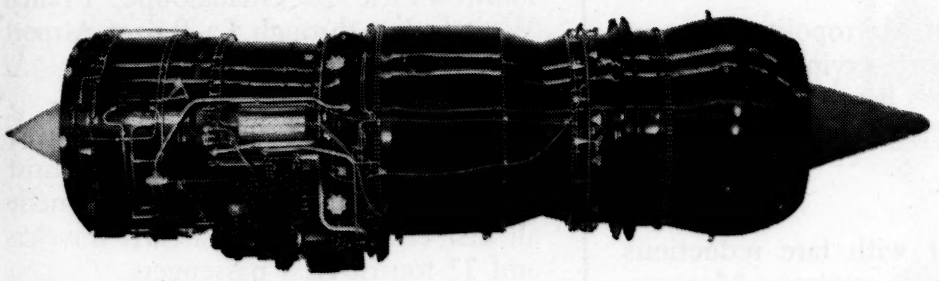
LIQUID HYDROGEN ROCKET ENGINE LR-115 (15,000 Lb.)



J75/JT4A (16,800-17,500 Lb.)



TF33/JT3D SERIES (17,000-18,000 Lb.)



J58/JT11 (30,000 Lb. class)

that spans the field of flight

Above the seven seas and across six continents, Pratt & Whitney Aircraft jet engines have carried more passengers to more places than all others in the world. They power 8 out of 10 long-range Douglas DC-8 and Boeing 707 jetliners — and all the medium-range Boeing 727s on order. They power the majority of our nation's frontline military jet aircraft. These jet engines have proved their dependability and economy in more than 15,000,000 hours of flight. The Pratt & Whitney Aircraft family of engines offers the broadest range of aircraft power available from any single source in the world. Liquid hydrogen rocket engines designed and built by Pratt & Whitney Aircraft will probe deep into space.

Pratt & Whitney Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION / EAST HARTFORD, CONNECTICUT

AIRLINE OBSERVER

► Trans World Airlines' semi-annual interest payment of $3.1 million on its 6½% debentures is based on 1960 results and is no assurance that the next payment due June 1, 1962, will be made on schedule. Terms of the debenture issue permit that the interest be paid only to the extent of available income of the previous year, and TWA 1961 results have been in the red so far. Price of the debentures, which have a relatively high interest rate, has been weak on the New York bond market recently, partly due to the prospect of interest deferment.

► **Estimates of domestic trunkline losses for 1961 now range between $30 million and $50 million. The pessimistic projections are based on increasingly high interest expense and the decline in revenue passenger miles. Some optimistic observers feel the loss forecasts are too high; that last quarter adjustments will reduce the loss figures some carriers have reported through the first three quarters. All, however, are generally agreed that the industry's final results will be far removed from a profit or even a break-even figure.**

► Aeroflot will begin regular weekly scheduled service between Moscow and Jakarta, Indonesia beginning Jan. 1. It will operate Il-18 turboprop transports over the route, which is the longest served by the state-owned airline.

► **Sabena Belgian World Airlines has reportedly decided to handle its 1962 helicopter network with its present fleet of five Sikorsky S-58 aircraft. New equipment purchases will be postponed until the company knows how the Air Union scheme will affect its scheduled helicopter service (AW Nov. 27, p. 50). Sabena has five S-58s remaining after selling two and losing one in an accident.**

► Plans for a $21-million terminal building at Detroit Metropolitan Airport call for combining all airline services at a single airport serving Detroit for the first time since 1958. During that period, six airlines have been operating into Willow Run Airport, and eight, including Flying Tiger and Riddle cargo lines, have been serving Detroit Metropolitan.

► **Russia's Aeroflot opened its winter season Dec. 1 with fare reductions averaging 10-15% and inauguration of new turboprop services. Moscow-Novosibirsk fare was cut seven rubles ($7.77 at the Soviet rate of exchange) and Moscow-Irkutsk tariff was reduced by nine rubles ($9.99). An-10A turboprop, 100-passenger transports were placed into operation on the Kharbarovsk-Yuzhnyi-Sakhalin, Novosibirsk-Sochi and Kharbarovsk-Magadan routes this month for the first time.**

► Lan-Chile Airlines, in its U. S. advertising, describes its installment plan as "go now—pay mañana."

► **Support for higher airline fares expressed in the report of the aviation committee of the Investment Bankers Assn. was not enthusiastic. Original draft took the stand that reduced, not higher fares, might be the answer. But collapse of the youth fare plan led to revisions of the original draft by committee members, and produced a stand for some reasonable form of selective fare relief—presumably coach adjustments. Some aviation financial experts now strongly question that the airline market is as inelastic as it once was believed. Others who disagree feel that a fare increase is a short-term necessity, but that CAB-recommended changes (AW Dec. 4, p. 37), such as pooling ground equipment, might be a better long-run solution.**

► Braniff Airways and Pan American last week filed an interchange agreement with the Civil Aeronautics Board which, if approved, would provide direct service between Houston, Dallas and London via Chicago in competition with KLM, only international carrier now offering through service from Houston to Europe. Daily flights will be operated with PanAm's Boeing 707-320 turbojet transports.

SHORTLINES

► **Allied Aviation Fueling Co.** of Virginia has a $50,037 Federal Aviation Agency contract to test aircraft fueling systems at Dulles International Airport, under construction outside of Washington, D. C. About 880,000 gal. of jet fuel and aviation gasoline have been trucked to Dulles for the testing.

► **Aruba's Prinses Beatrix Airport** in The Netherlands West Indies will undergo a $6.7-million improvement and expansion program. Runway will be lengthened from 6,445 ft. to 9,000 ft. to accommodate large jet aircraft and a new terminal building will be constructed. Work will begin next summer and will be completed in 1963.

► **Cathay Pacific Airways** of Hong Kong has bought a Convair 880-M jet transport scheduled for delivery next March. The aircraft, which will be put into service between Hong Kong, Formosa and Japan, will seat 24 first-class passengers four abreast and 70 economy passengers five abreast.

► **Caribbean Atlantic Airlines** has Civil Aeronautics Board permission to serve Pointe-a-Pitre in Guadaloupe, French West Indies through La Raizet Airport after Dec. 1.

► **Delta Air Lines** reports its Convair 880s now contain first-class and tourist accommodations. The aircraft, formerly all first class, seat 56 first-class travelers and 32 tourist-class passengers.

► **Eastern Air Lines** has omitted its cash dividend for the fourth quarter and the 2% annual dividend in stock. Eastern reports the action was taken to conserve cash to finance jet aircraft on order.

► **Irish Airlines** reports a 145.2% increase in passenger traffic during October on its European-North American route, compared with October, 1960. It reports an operating surplus of $1.4 million for the six-month period ending Sept. 30.

► **North Central Airlines** board of directors has voted a stock split plan giving stockholders three additional shares of stock for each share they own.

► **Western Air Lines'** stewardesses, as a result of a new contract between Western and the Air Line Stewards and Stewardesses Assn. (AFL-CIO), will receive pay increases averaging $44 a month. Contract calls for bonuses up to $12 a month for senior stewardess duties and an 8% pay increase retroactive from Jan. 1 to Nov. 1, 1961.

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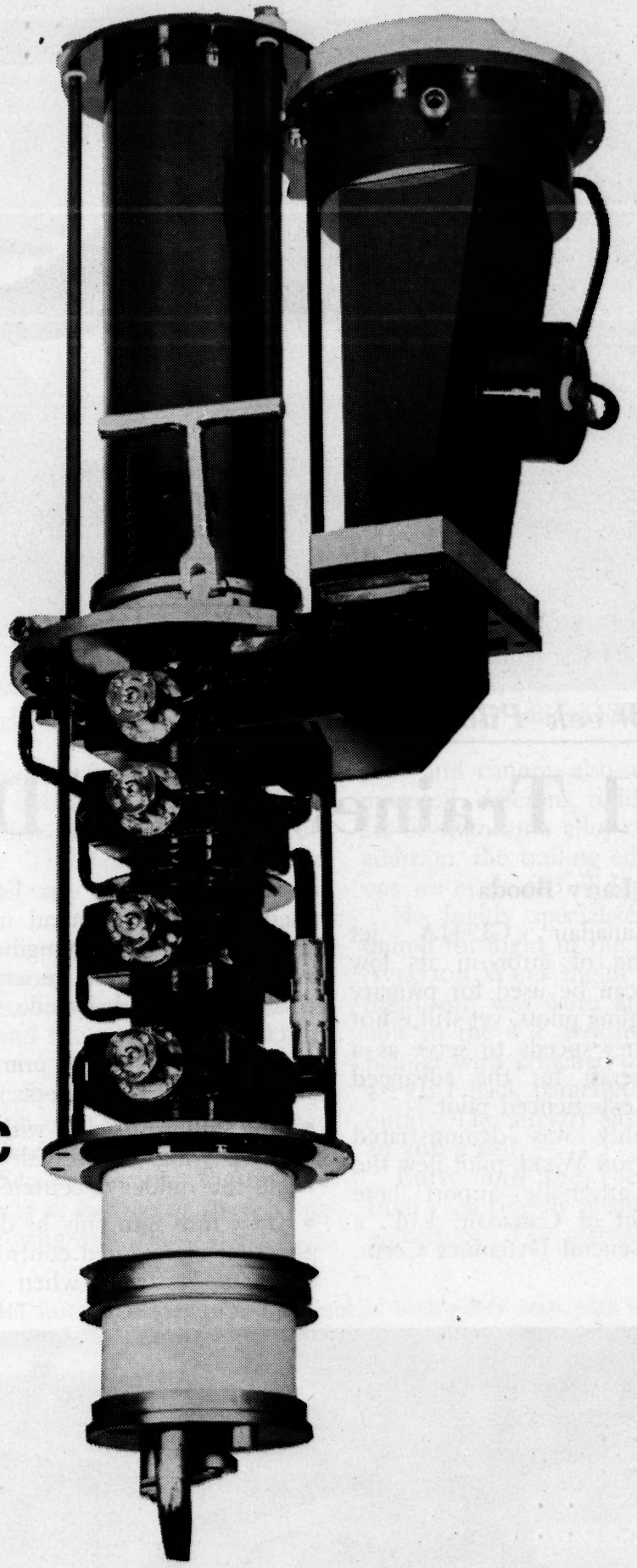

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3. Minimum 3db bandwidth: 12Mc
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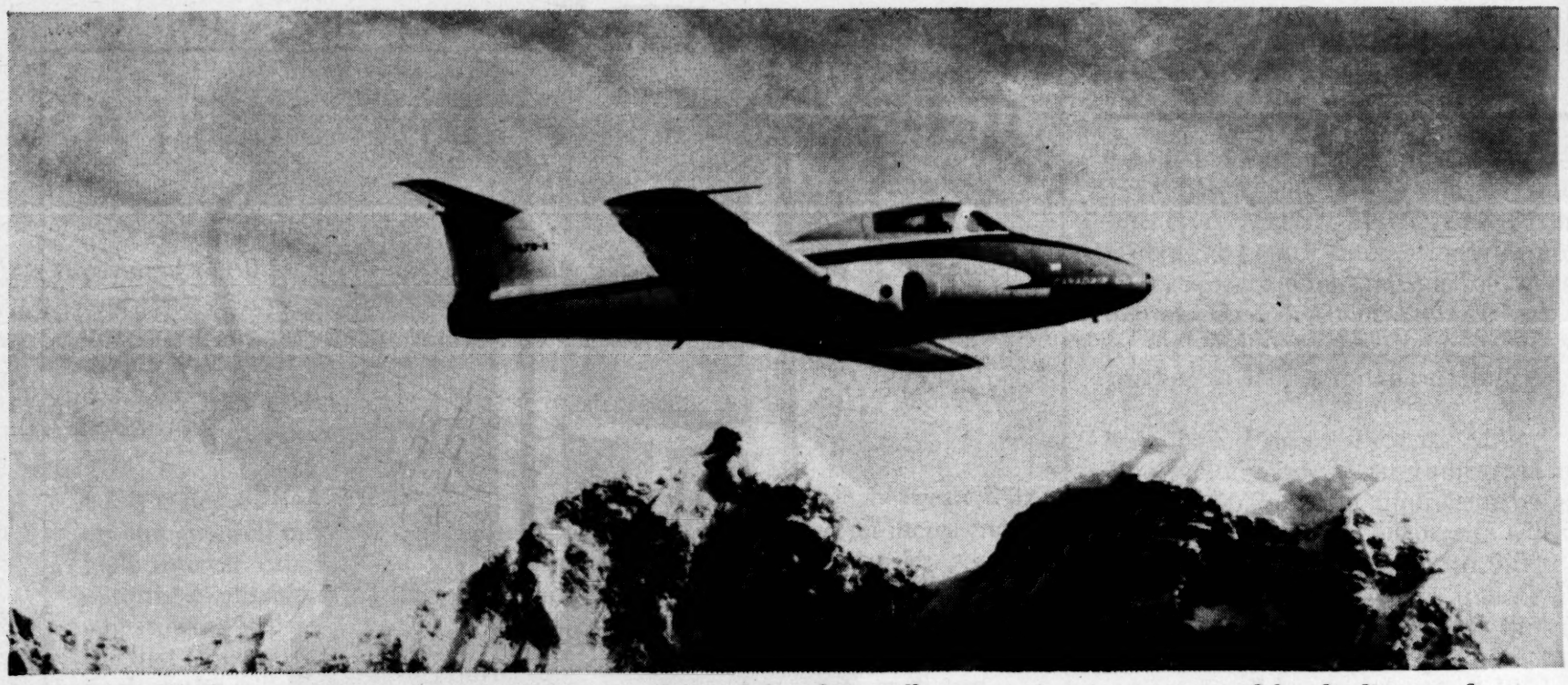


CANADAIR CL-41 is a primary and transitional trainer, designed for clean stalls, automatic spin recovery and low landing speed.

Aviation Week Pilot Report:

CL-41 Trainer Meets Demands Over Wide S

By Larry Booda

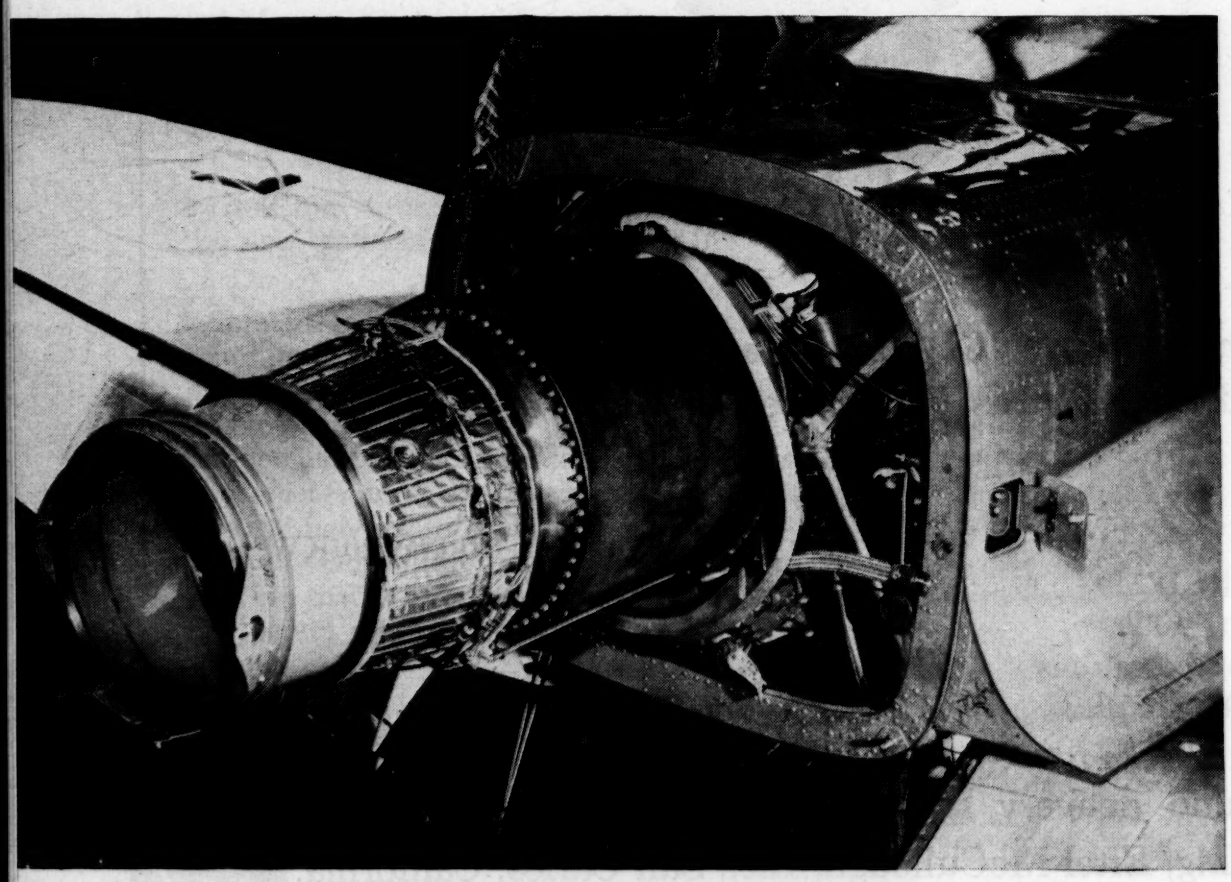
Montreal—Canadair CL-41A jet trainer—forgiving of error in its low speed regime—can be used for primary training of fledgling pilots, yet still is hot enough at higher speeds to serve as a transitional aircraft for the advanced student or the experienced pilot.

This versatility was demonstrated when an AVIATION WEEK pilot flew the airplane at Cartierville airport here where the plant of Canadair, Ltd., a subsidiary of General Dynamics Corp., is located.

Royal Canadian Air Force requirements dictated a broad mission spectrum, which design engineers have in substantial measure incorporated into this two-place, side-by-side, single-engine aircraft.

For training of the primary or basic student, the CL-41 offers:

- **Full stall** combined with the ability to keep wings level with the ailerons while the rudder is centered.
- **Entry into spin** only by deliberate application of required control forces and automatic recovery when controls are freed except under non-standard trim and loading conditions.
- **Landing at moderate speeds** with eye level close to the ground for better height judgment.
- **Standard techniques for performance** of low speed acrobatics.
- **Side-by-side seating,** permitting the student to observe control movements while the instructor is demonstrating maneuvers.
- **Economical operations** below 15,000 ft. Low altitude fuel consumption of many jets is high, prohibiting low altitude missions.



TAIL SECTION may be removed rearward to permit engine work to be done.

For the advanced student or for pilots whose experience has been in propeller-driven aircraft, the CL-41 offers the following:

- **Sufficiently high subsonic speeds** to demonstrate the effects of compressibility.
- **Standard responsiveness** in performing high speed aerobatics.
- **Ability to withstand** and demonstrate high positive and negative accelerations.
- **Aerodynamic characteristics** of the "clean" aircraft and training in the use of speed brakes.
- **Familiarization** with the use of protective helmets, oxygen masks and cockpit pressurization.
- **Jet engine operation,** including introduction to the relatively slow power response after rapid throttle opening when compared with reciprocating and turboprop engines.

In order to fill a gap in the training spectrum prior to introducing pilots to operational types of aircraft, the RCAF has specified development of the CL-41R, a version of the basic air-

ROYAL CANADIAN AIR FORCE has ordered 190 of the single-engine trainers and NATO and non-NATO nations have shown interest.

e Speed Range

craft which will carry the radar and other electronics gear of the Lockheed F-104 and the Canadair CF-104 fighter aircraft. In this configuration, it will serve as an intercept trainer.

Thus it is possible that, in the future, many RCAF fighter pilots will have flown only the CL-41 before reaching combat units.

Canadair Sales Effort

At present, Canadair is assured of selling 190 of the jet trainers. Beyond that, the company has made a major sales effort in Europe, where the engineering test model, its development program completed, was flown by pilots of the air forces of several NATO nations. Pilots of the U. S. Air Force and U. S. Navy also have flown it.

The CL-41 now is in the plant having changes incorporated in it which will appear in the production model. Target price is less than $200,000.

Powerplant for the CL-41 is the Pratt & Whitney JT12A-5 (J60) axial flow turbojet which is designed to produce 2,900 lb. of static thrust at sea level, military rating. For this installation, however, a stop limits engine speed to 95% rpm. or approximately 2,400 lb. thrust. With this conservative limitation, prolonged running of the engine at high rpm. will not be possible. This type of operation further permits 800 hr. engine time before the first overhaul.

Alternate engines are the Bristol Siddeley Viper, General Electric J85 and Rolls-Royce RB.145.

The most unusual features of the CL-41 are its low slung appearance and T-empennage configuration. Highest part of the aircraft is the top of the vertical stabilizer which is 9 ft. 3¾ in. off the ground. The bottom of the nose portion rests only two feet above the ground.

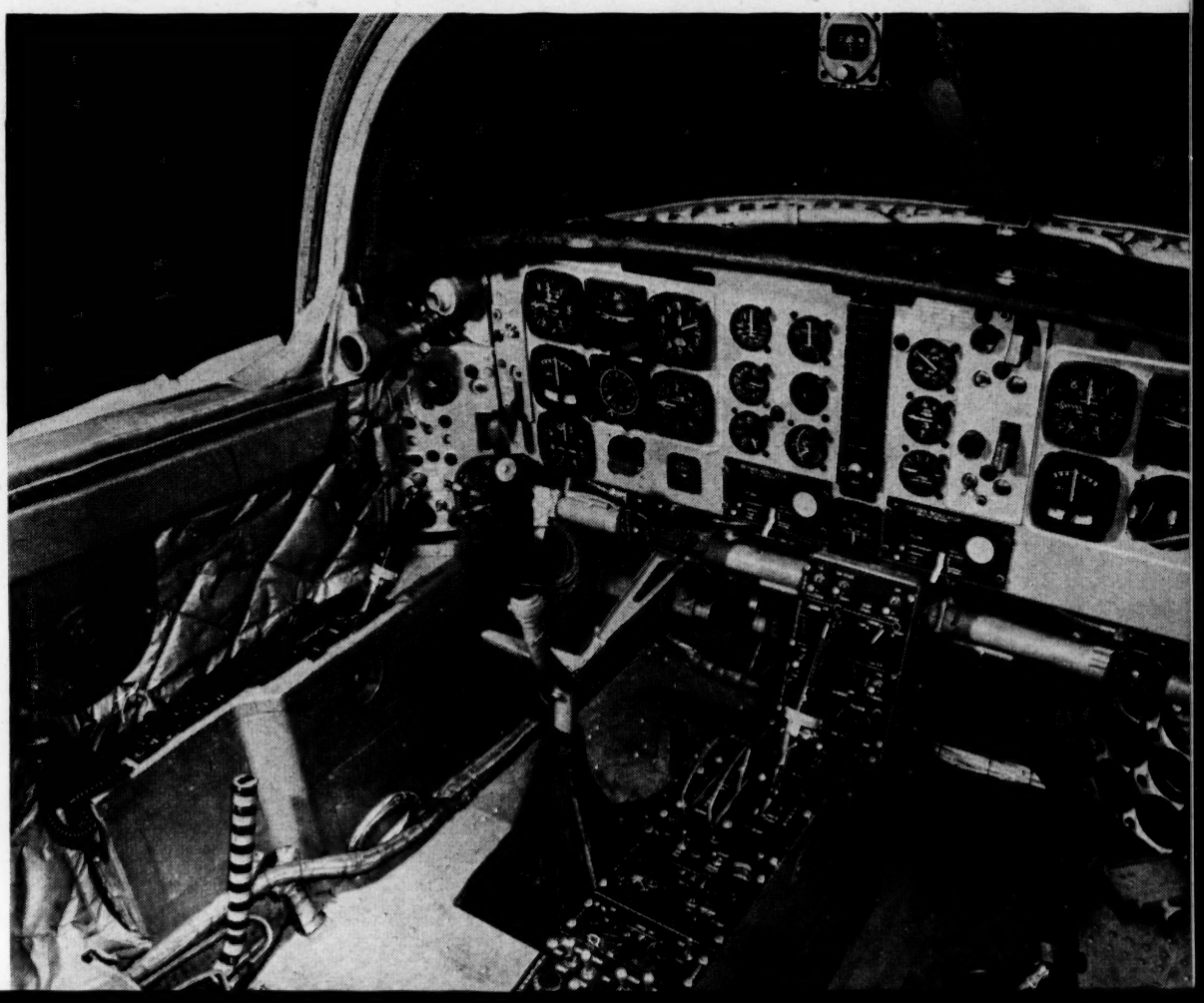
Span of the unswept wing is 36 ft. 4 in. and the length of the aircraft is 32 ft. Main landing gear tread is 13 ft. 2.5 in. and the wheel base is 11 ft. 1 in. Gross weight is 7,300 lb.

Hydraulically operated speed brakes are located on each side of the fuselage below the leading edge of the vertical stabilizer. Screens covering the divided air inlet ducts in fairings at the leading edge of the wing root, the landing gear, flaps and canopy also are hydraulically operated. Ailerons, rudder and elevators are of aluminum alloy construction. In addition, the trailing edges of the ailerons are made of full depth honeycomb.

No highly specialized gear was required for flight in the CL-41. For the AVIATION WEEK flight, a standard light flight suit was worn and was comfortable in the 43F weather. A protective helmet with attached oxygen mask and a P9B-1 back parachute completed the outfit. The aircraft has connections for an anti-g suit.

Entry into the cockpit was made from each side by means of two retractable steps. The instructor may occupy

DUAL FLIGHT instruments are placed in front of both pilots' seats with engine instruments centered. There are no overhead controls.



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NOW IN OPERATION—Humble Oil and Refining Company, Houston, Texas

the left seat with beginning students and move to the right after the student has mastered operation of the principal controls.

The two Weber ejection seats are separated by a narrow central console in the roomy cockpit. In this instance both pilots weighed more than 190 lb. yet were able to operate the aircraft without interference to arm or leg movements.

Flight controls are identical for both positions. Control sticks are mechanically interconnected by push-pull torque tubes and are topped by the USAF B-8A type hand grip which incorporates buttons for nose wheel engagement, elevator and aileron trim and intercom.

Rudder pedals are the toe brake type and are adjustable by means of a small wheel located under the instrument panel on each side.

The flight group of instruments is directly in front of each position. Included are an airspeed indicator, attitude indicator, altimeter, vertical speed indicator, heading indicator, turn and bank indicator and machmeter. A standby magnetic compass is installed on the center beam of the windshield.

The center panel contains a percentage type tachometer, exhaust temperature, exhaust pressure ratio, fuel quantity, oil pressure, oil temperature, flap and hydraulic pressure indicators and fire extinguisher actuator switches. Below the center panel are separate oxygen regulator panels. The oxygen system is the liquid type with a capacity of 5 liters.

The forward part of the center console holds the engine master, starting, anti-icing, start-stop, inverter, cockpit lights, battery and generator switches.

To the right of the right hand seat is a fuse panel.

Automatic direction finder, interphone, VHF and air conditioning and circuit breaker panels are located behind the throttle and flap controls of the right hand seat.

To the left of the left side pilot's position is the master throttle which incorporates a detent at the engine idle position to prevent inadvertent shutting off of the engine fuel. Beside it is the flap control.

At the top of each throttle is a two position speed brake control button.

Behind the throttle on the left side are elevator and aileron alternate trim controls and a canopy declutch and hand crank for alternate operation. Forward of the throttle on the vertical panel are the landing gear handle, the canopy actuating switch, canopy jettison switch, demist and defrost switch, landing gear override switch, hydraulic emergency selector, landing and taxi lights switch, accelerometer and drag chute release and jettison switch. The emergency hydraulic hand pump is on the floor and located to the left of the left hand seat.

The Weber ejection seats are adjustable up and down. Sequence for ejection includes:

- **Raising a handle** on either pilot position jettisons the canopy and locks the shoulder harness.
- **The seat** can then be fired by a trigger. It is not possible to squeeze the trigger until the canopy jettison handle is raised nor can the shoulder harness be unlocked.
- **As the seat leaves** the aircraft, the M-12 initiator is triggered and one second later actuates the release of the safety belt. The ability to unlock the seat harness is unaffected by the automatic features.
- **As the pilot separates** from the seat the rip cord of the parachute, which is fastened to the left lap belt, is pulled automatically.
- **When the seat is ejected** the anti-g suit, oxygen hose, microphone and headset connections are automatically broken at one fitting.

Only one unfavorable feature about the ejection seat installation was noted. If the legs are outstretched or are off center at the time of ejection, they could be injured. No stirrups are provided.

Engine starting procedure is simple. When the master switch is turned on, a booster pump located in the collector sump for the five fuel cells is started. The starter switch is actuated by pulling out the knob to unlock and depressing it to start the engine turning over. At 10% rpm., the throttle is pulled out of idle cutoff past the detent into the idle position starting the idle flow of fuel to the engine.

If a hot start is indicated by the temperature gauge, the throttle is again

CL-41 Specifications

Wing span	36 ft. 4 in.
Length	32 ft.
Height (tail)	9 ft. 3¾ in.
Height (canopy)	7 ft. 2 in.
Ground clearance	1 ft. 9¾ in.
Horizontal stabilizer width	13 ft. 7 in.
Cockpit width at canopy sill	4 ft. 3 in.
Cockpit width at consoles	3 ft. 11¾ in.
Seat spacing	2 ft. 2 in.
Normal mission gross weight	7,300 lb.
Ferry mission with drop tanks	8,460 lb.
Empty weight	4,870 lb.
Fuel, internal	1,440 lb.
Fuel, external	967 lb.
Fuel	JP-4
Alternate	JP-1
Emergency	Gasoline
Maximum cruise speed	418 kt. TAS at 30,000 ft.
(Note: no reduction for turbulence)	
Rate of climb, initial	3,650 fpm.
Rate of climb, 30,000 ft	1,200 fpm.
Time to climb to 30,000 ft	14.5 min.

measurement and control

of pressure and differential pressure

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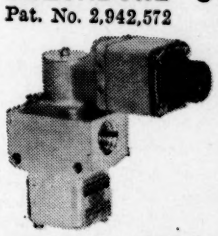
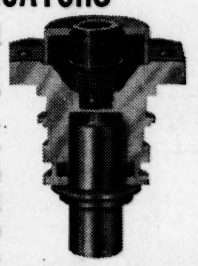


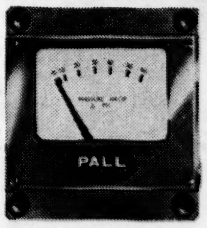
Adjustable for signalling pressure and differential pressure from 0.25" wc to 200 psi (or psid) in systems to 5000 psi and −65° to +275°F; leakproof. Units sound alarm, light bulb, turn motor on or off, operate valves — remotely or in place. $40 to $75

DELTADYNE INDICATORS



Adjustable and non-adjustable. Actuation 0.01 to 100 psi (or psid). For same pressure/temperature as switches. Red button pops to give visual indication of overpressure. $22 to $85

DELTADYNE GAUGES



For system pressures to 3000 psi; indication from 0 to 60 psi differential; leakproof — no moving seals; high-visibility scale. 0 to 60 psid, 3000 psi w.p. model. $92

TRANSMITTERS Complete with remote or in-place recorder.

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- **Process industries (chemical, petroleum, fuels)**
- **Equipment manufacturers (fluid handling)**

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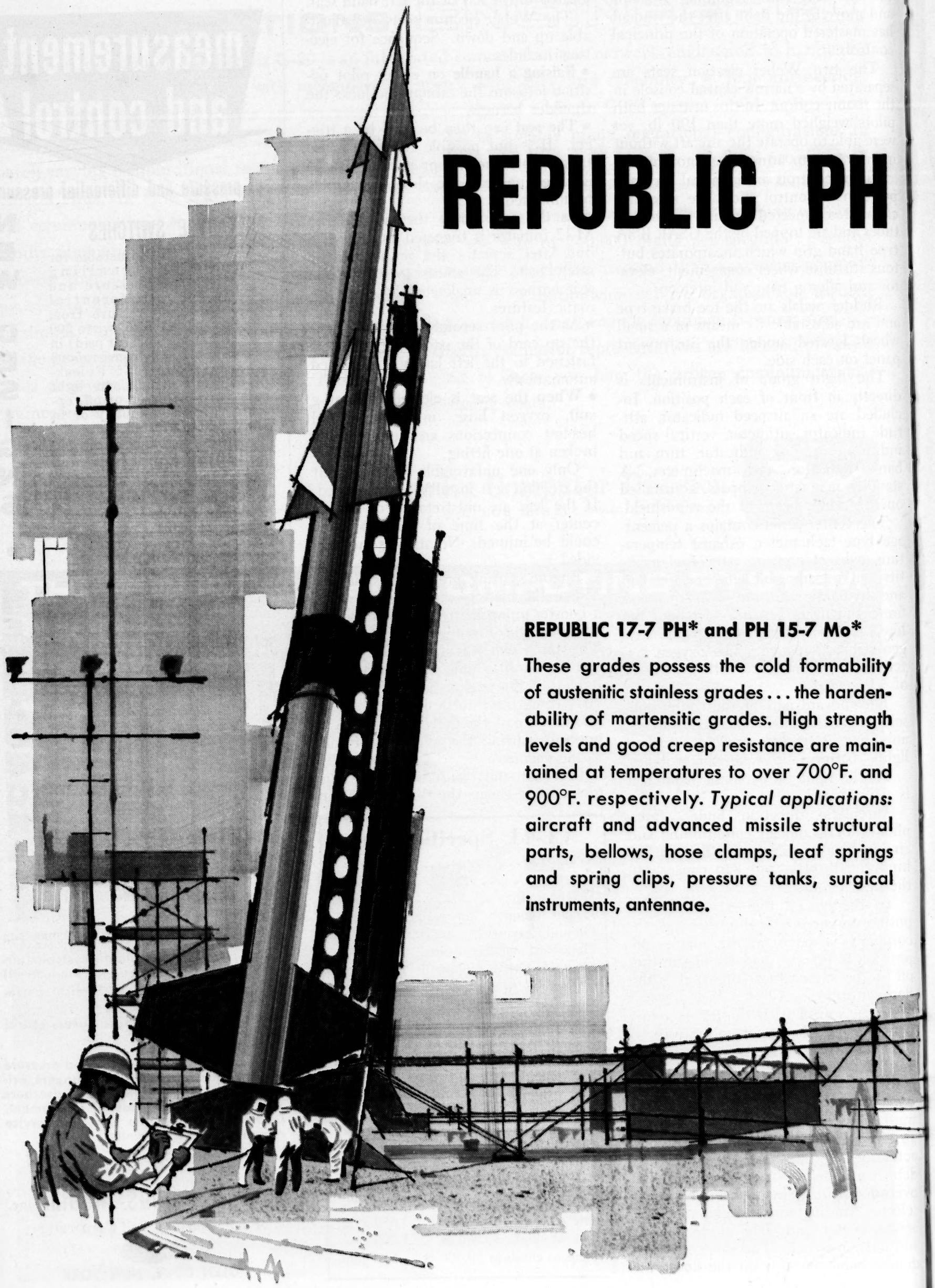

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These grades possess the cold formability of austenitic stainless grades . . . the hardenability of martensitic grades. High strength levels and good creep resistance are maintained at temperatures to over 700°F. and 900°F. respectively. *Typical applications:* aircraft and advanced missile structural parts, bellows, hose clamps, leaf springs and spring clips, pressure tanks, surgical instruments, antennae.

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REPUBLIC 17-4 PH*

Simple heat treatment after fabrication develops high strength levels without excessive distortion or scaling. Unlike most martensitic chromium types, Republic 17-4 PH* is welded without preheating or post annealing, thus resulting in lower fabricating costs. *Typical applications:* bearings, bolts, shafts, aircraft fittings, gears, splines, mandrels, pins, seats, and valves.

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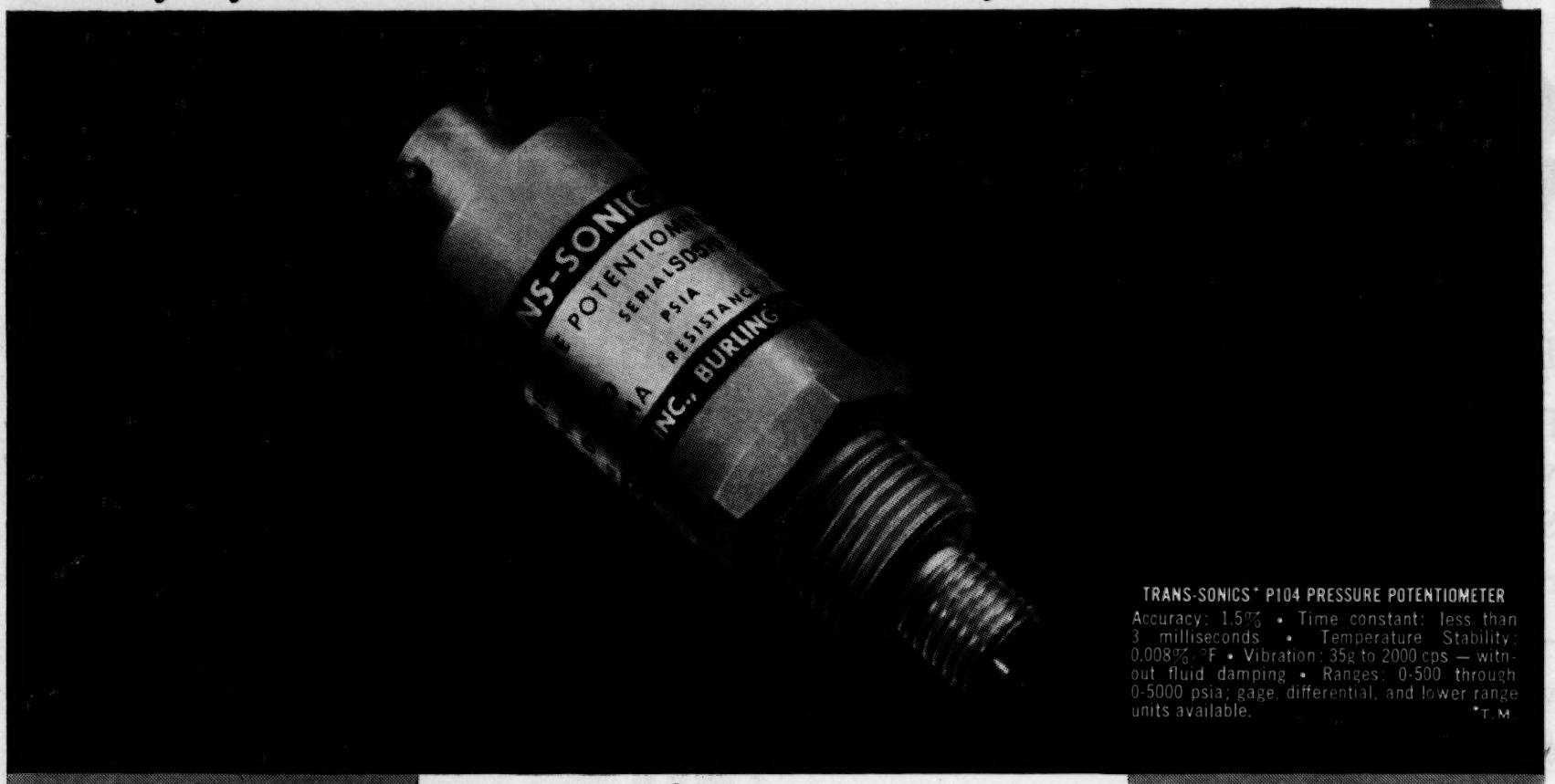

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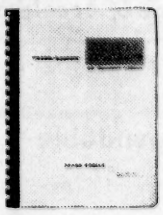

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moved to the cutoff position. Idle rpm. is normally 40% or over. In this instance it was 43%.

To begin taxiing, a slight advance of the throttle was necessary followed immediately by retarding it to the idle position. This setting is sufficient to maintain a taxiing speed of approximately 20 kt.

Steering normally is done by the hydraulically powered nose wheel. This is engaged by pressing a button on the stick. The rudder remains engaged through a throw of 45 deg. each side of center. The aircraft can turn in a circle of less than 40 ft.

It takes a conscious effort to keep the nose wheel engagement button depressed and over an extended taxiing period this can result in a tired thumb. Steering can be done by differential braking also.

This type aircraft normally would not need power steering. The RCAF, however, took into account operating conditions over long winter months when differential braking is ineffective on ice and both impacted and soft snow.

Cockpit Height

When taxiing the CL-41 for the first time, the pilot is impressed with the closeness of the cockpit to the ground. This peculiarity is amplified during takeoff and landing maneuvers.

The brakes, steering, flight instruments, demist and deice operation, ADF and anti-g suit, if worn, are checked while taxiing.

The pre-takeoff check list includes the hydraulic pressure, harness, control trim, throttle friction, fuel, flaps setting, speed brakes, gyros, switches, controls, canopy and annunciator panel.

A full power turnup was quickly accomplished, during which all engine instrument readings were checked for normal indications.

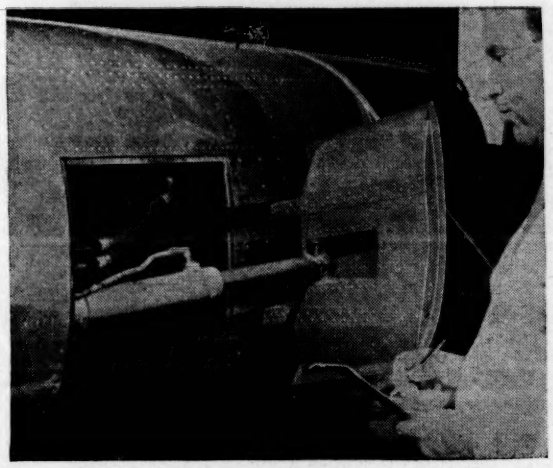
Takeoff power application can be slow or rapid. It was eased on for the first takeoff. The greatest surge of power was noticed in the last inch of the throttle throw.

Assistant Chief Engineering Test Pilot Ian MacTavish explained that he normally took off with the nose wheel steering engaged for the first 40 or 45 ft. This was done but was not needed because a 10 to 12-kt. wind was coming directly down the runway.

Rudder control was noted at about 50 kt. Slight back pressure was applied to the stick at this point, but was not immediately effective. Between 70 and 85 kt. the nose wheel came off rapidly and rotation was checked in a mildly nose high attitude. Airspeed built up rapidly as the landing gear was raised.

At 110 kt. the flaps were raised, necessitating a slight change in elevator trim nose up.

It was at this point that the visibility advantages of the CL-41 became apparent. Downward visibility was almost vertical because the seat is ahead of the wing and horizontal sight sweeps through 300 deg.



LARGER SPEED BRAKES are planned for production models of the CL-41.

Optimum climb speed is 175 kt. Initial rate of climb is 3,650 fpm. Rate at 30,000 ft. is reduced to 1,200 fpm. Time to climb to that altitude is 12.3 min.

Air work was first on the schedule. Since aerobatics must be performed during conditions of full ground visibility, the air corridor was limited to an off airways area about 20 by 50 mi. in size.

The rpm. was reduced to 85% at 12,000 ft. Straight and level flight at this setting produced an indicated airspeed of 212 kt., which was computed to be 268 kt. true airspeed.

Shallow turns to the left and right were made and altitude was easily maintained. Then steep turns were tried. Maintaining altitude during the latter was not as simple at first until the proper amount of back stick pressure was determined. Acceleration forces in these turns were mild, not more than 2g at any time. Tendency was to gain altitude in left turns and lose altitude in right turns.

Stall Performance

Stalls were tried next. In the clean condition and the throttle in idle position, speed decayed slowly in a slight nose up attitude. The nose was raised to about 20 deg. As the stick came all the way back and the indicated airspeed was 85 kt. there was some stick shake but the full stall came suddenly. With the rudder centered and the stick all the way back there was still enough aileron control to keep from dropping off on one wing. The nose dropped but then came up again.

Stalls with the landing gear and flaps down and speed brakes extended were similar, but the warning came sooner. The stall under these conditions was at 73 kt. Only slight forward motion of the stick was required to terminate the stall in both the dirty and clean conditions.

Production models of the aircraft will have a stick shaker installed as a stall warning device.

The stall curve is not as broad as that of many other training aircraft, but it is more honest than operational aircraft. It compares closely with the North American/USAF T-6.

Rolls with the nose slightly high at the beginning and an indicated airspeed of 200 kt. were tried to the right and the left. At this speed top rudder had to be applied in the vertical position.

Rolls at higher airspeeds were not tried but were described as being similar to the aileron rolls of the Lockheed T-33.

Spins to the right and left must be entered deliberately, with the stick full back in a stalled condition and using full rudder. Recovery can be speeded by reversing controls, but this isn't needed. The CL-41 will recover from spins of its own accord when the controls are released.

No rudder control is necessary as the airspeed slows at the top of the loop as is the case with a propeller-driven aircraft. Keeping the aircraft level with the horizon while upside down at the top of the loop is difficult, since the wings are behind the pilot.

Control Surfaces

Control forces of the CL-41 are not light. Neither are they as great as found in large aircraft lacking control boost. All the surfaces are moved by means of push-pull rods or torque tubes and there is no servo boost. If static and dynamic stability were sacrificed forces would permit finger tip control, but the aircraft would not be forgiving of lack of attention with the beginning student.

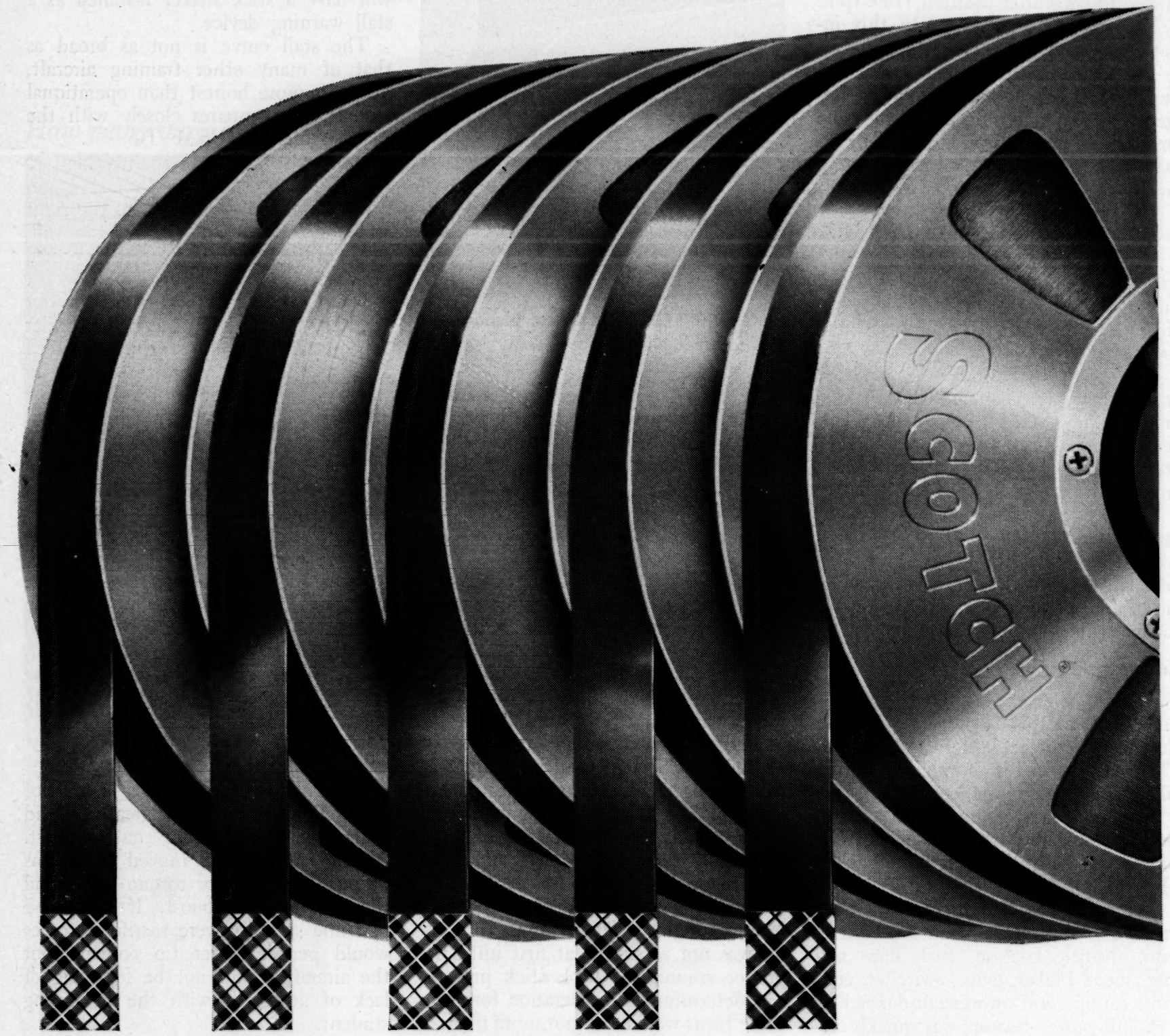
Pressurization of the cabin begins at 8,000 ft. It remains at this altitude pressure until 3 psi. differential is reached, somewhere around 20,000 ft. The cabin was comfortable despite an outside temperature of −30C.

The main runway at Cartierville has been lengthened to 8,800 ft. to accommodate the CF-104 which Canadair is building.

Traffic pattern for Runway 10 was set up downwind at 1,000 ft. after a pass up the duty runway.

Speed brakes were extended first and the landing gear was lowered when the airspeed was below 175 kt. Preferably, this is at 160 kt. The downwind leg was flown at 135 kt. Turning base leg, with rpm. set at about 68%, half flaps were set and descent was begun. Elevator trim adjustments in the nose up direction were necessary with flaps down.

Approach visibility is excellent and lineup with the runway offered no problems. The final straightaway was entered at 115 kt. and the over-the-fence speed



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was 95 kt. The CL-41 was leveled off about 20 ft. in the air, which, MacTavish explained, was the standard reaction of pilots who are accustomed to having cockpits sit higher off the ground. Nevertheless, the aircraft forgave this misjudgement and landed smoothly in spite of a higher sink rate than desirable.

A running takeoff was made, with only throttle advance, flap change from full-down to half and speed brake retraction necessary while on the runway.

As a test, the brakes were applied on the final landing. Action was positive and not sensitive since they are unboosted.

The canopy cannot be opened at speeds greater than 40 kt. because of the danger of it blowing off.

Engine shutdown is done simply by slipping the left hand throttle around the detent to the idle cutoff position.

The JT12 engine operating limitations are few. At 95% rpm., maximum exhaust gas temperature is 538C, while oil pressure can be 45 psi, ±5 psi. Oil temperature for all powers can vary from 40 to 120C.

Maximum allowable exhaust temperature at starting is 635C.

While undergoing accelerations, such as in tight turns, the maximum time allowed is two minutes, the maximum exhaust temperature is 666C and the oil pressure limit is the same as for maximum continuous power. Minimum oil pressure allowed is 35 psi. while idling.

The engine is not designed for extended negative g conditions because oil ceases to flow to some bearings above 3F and fuel flow ceases under 3F. Negative g can be imposed a maximum of 15 sec. at 3F and above, and 12 sec. from −65F to 3F.

Diving Speed

The limiting diving speed of the CL-41 is 500 kt. equivalent airspeed and the limiting Mach number is 0.8, which is 500 kt. EAS at 3,000 ft.

Positive g limit is 7.33. The negative limit is 3g. All the limits apply up to a weight of 6,500 lb. Maximum landing gross weight is 6,300 lb., but the controlling factor is the landing gear and not the airframe.

A hydraulic system hand pump is available in the event of engine driven pump failure. If there is a leak in the system there is enough fluid remaining in the tank below the standpipe level to allow the landing gear to be lowered with the hand pump.

The aircraft is stressed to 8g vertical and 24g forward, which permits wheels up landings in terrain rougher than agricultural fields. In the event of engine fire on the ground there are spring loaded doors where carbon dioxide hoses can be inserted.

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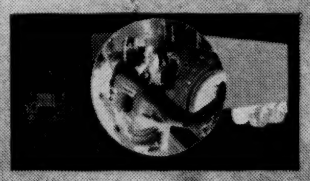

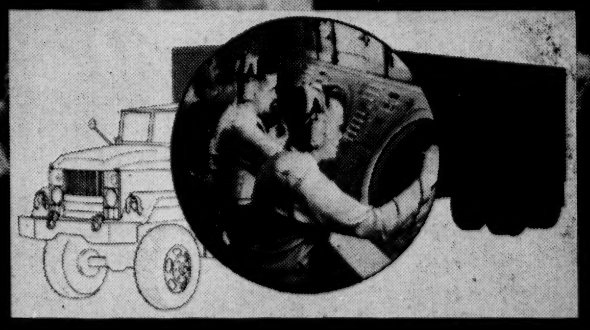

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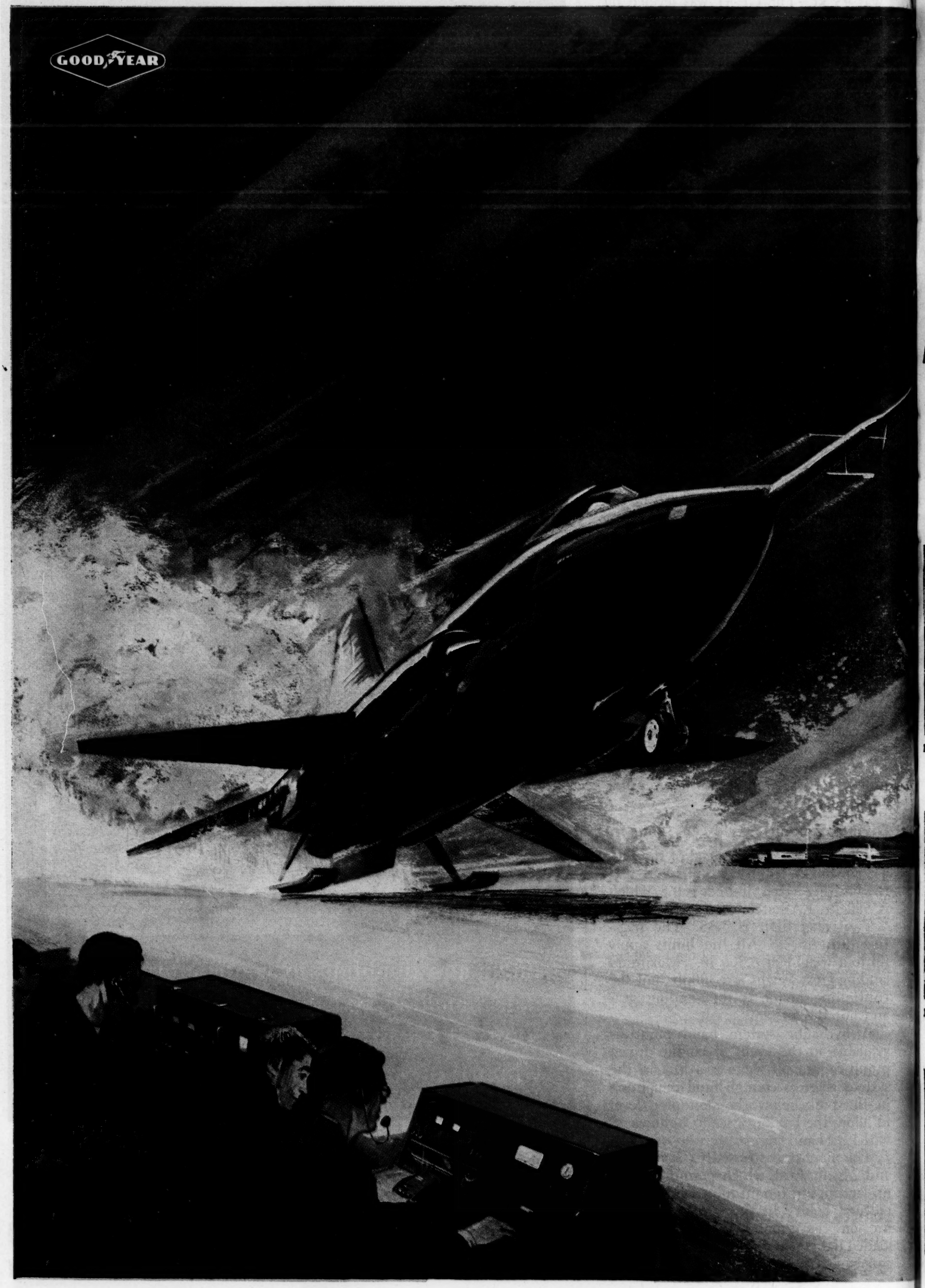
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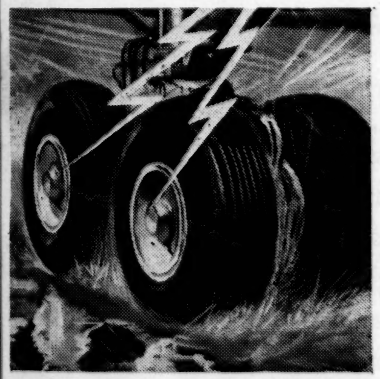
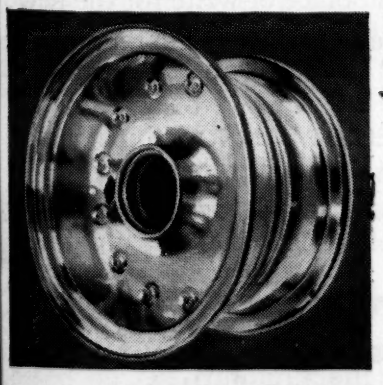
Automatic braking system helps take skid problems out of high-speed landings!



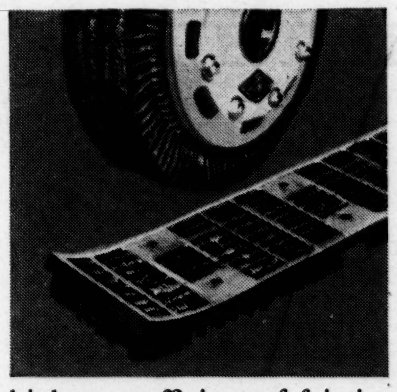
Automatically adjusts itself to runway conditions – prevents tire flat-spotting and skid blowouts – shortens stopping distance—instantly adapts the pressure of the brake to the coefficient of friction between the tires and *any* runway surface. Eliminates human element in aircraft braking. An *exclusive* Goodyear development of high reliability in being today.

Corrosionproof aircraft wheels that take 1,000°F!



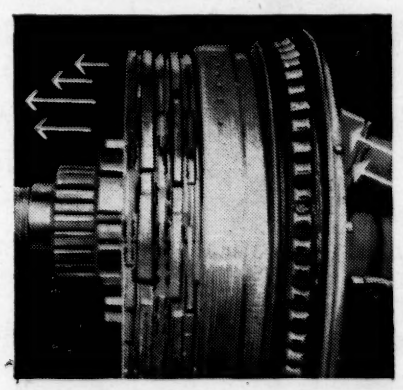
Fully tested and ready for production, new aircraft wheels of two never-before-used materials are corrosionproof – stronger and lighter than wheels currently used. One of these Goodyear wheels will withstand 1,000°F, keep tires cooler because they transmit heat at far lower rate. Thinner sections free more space for brakes, better flexibility resists higher impact loads.

Wire tires & skids for the hottest landings!



You can't use regular tires on re-entry vehicles without incurring severe design penalties (re-entry heat bars exposed rubber). But you *can* use these *exclusive* Goodyear wire tires and skids. Made of a Goodyear-created high-temperature stainless steel, they give the "hottest" ships a landing capability for the first time – have the highest coefficient of friction of any landing skid system.

Cool solution for disc-brake heat problem!



Air-cooled brakes by Goodyear give disc brakes more capacity by eliminating overheating *without* increasing disc size and weight. Use no liquid, no hose, no complex pumping and cooling system—give you every "cooled" brake advantage without extra weight and cost penalties. Another advanced development *in being* at Goodyear.

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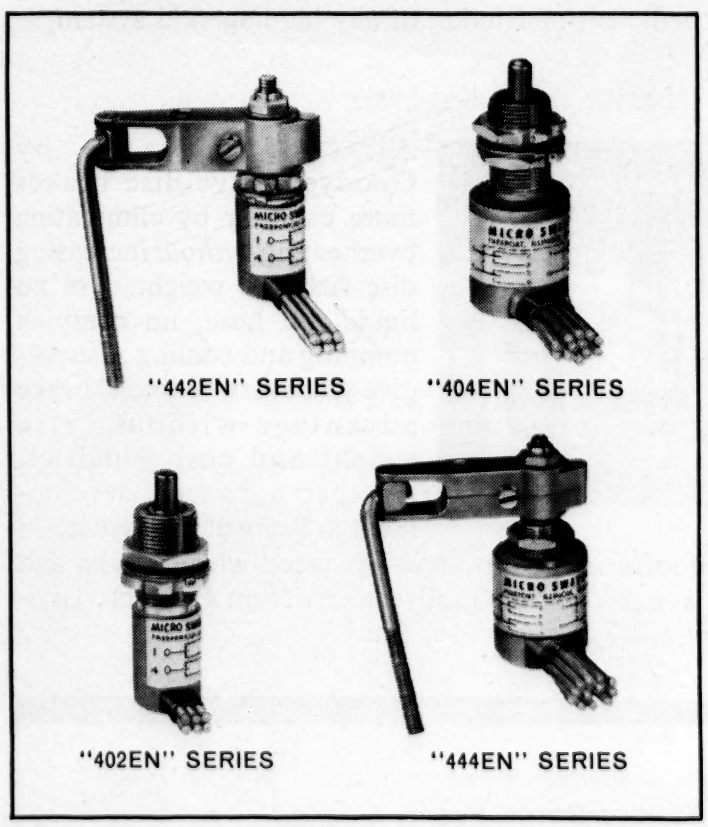

"400EN" Series includes these models: 2-pole plunger, 2-pole rotary, 4-pole plunger and 4-pole rotary.

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Glass Fiber VTOL Propellers Proposed

By James D. Hendricks

Three-way competition is developing for the propeller subcontract in the tri-service VTOL transport program, with glass fiber designs favored in early proposals by two firms.

Hamilton Standard Division of United Aircraft Corp., Curtiss-Wright's Curtiss Division and General Motors' Allison Division are seeking the subcontract, which will be awarded by Hiller Aircraft Corp. Hiller, teamed with Ling-Temco-Vought and Ryan to develop the transport (AW Sept. 25, p. 352), has responsibility for propellers, transmissions, gearing and shafting.

Hamilton Standard and Curtiss-Wright have conducted preliminary discussions with Hiller, and Allison is expected to make its first proposal in the near future.

Although Hiller has not limited the competition to those three firms, they appear to be the major contenders. "It will be some time before any decision is reached on propeller selection," a Hiller official told AVIATION WEEK. "We've got a good deal of study yet to go."

Hiller is in the process of establishing propeller performance criteria for the transport, but the company is not active in designing a propeller of its own, he added. No dollar estimate is available as yet on the subcontract.

Glass Fiber Advantages

Glass fiber propeller suggestions are receiving the most serious consideration, though not to the exclusion of conventional steel and aluminum alloy types. This emphasis on glass fiber seems to stem mainly from the possibilities it affords for significant reduction of propeller weight, a vital factor in the development of the transport.

Hamilton Standard and Curtiss-Wright have offered suggestions for glass fiber propellers basically along lines of models which already were under development by those companies prior to initiation of the VTOL transport program.

Allison, which now produces primarily hollow steel blades bearing the Aeroproducts name, is withholding preliminary recommendations until Hiller has established its criteria, an Allison official said. "We definitely plan to enter the competition at that time," he added.

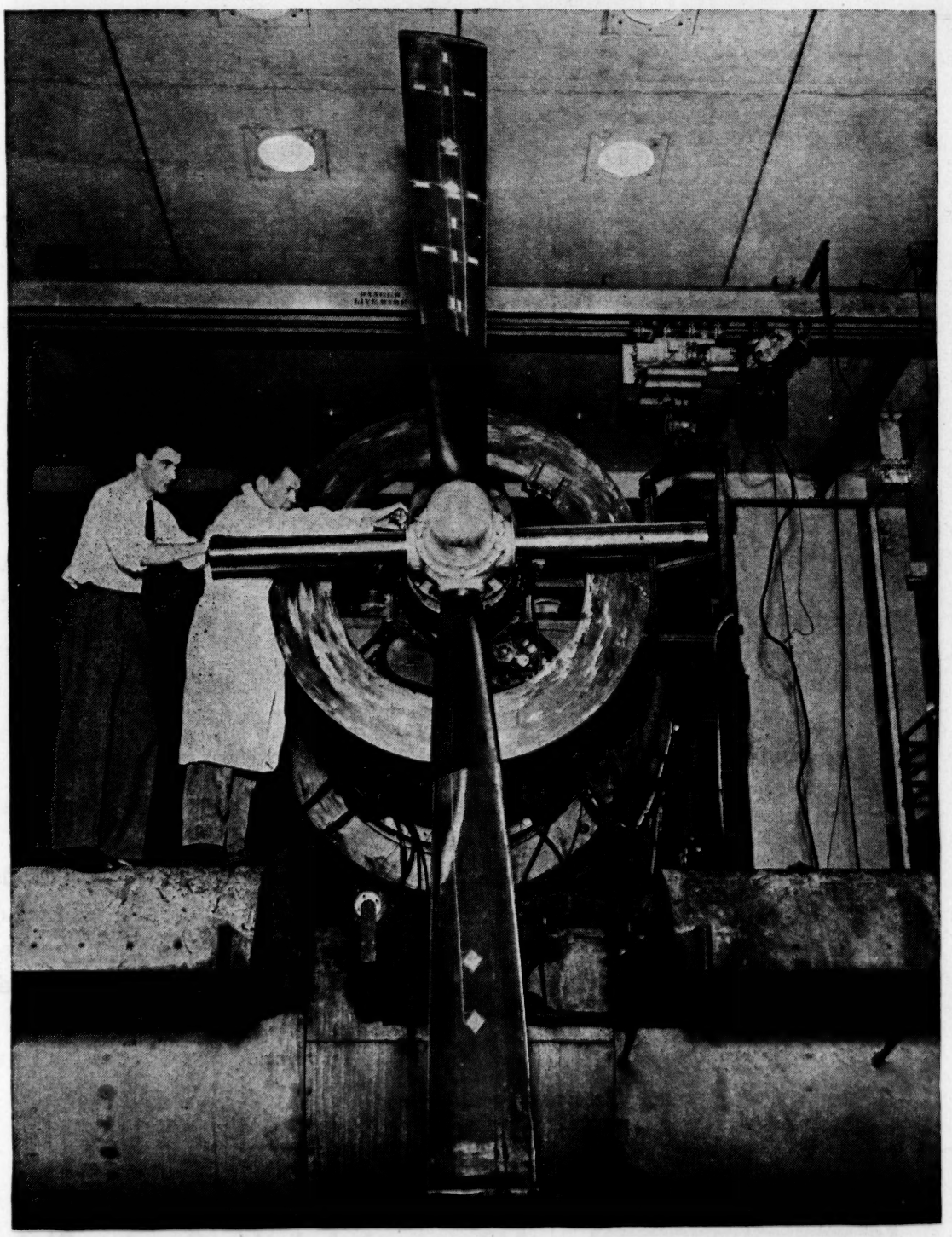
Hamilton Standard is developing a propeller which utilizes a glass fiber blade fitted over a steel spar which is attached to the hub. This design is based on the combination hollow steel blade and steel spar propeller, which Hamilton Standard has produced since 1946 for the Lockheed P2V aircraft.

Engineers at Hamilton Standard say the glass fiber blade could cut total propeller weight as much as 20%, regardless whether the propeller uses conventional or variable camber. The company's glass fiber blade reportedly would allow weight reduction in hub, barrel and related propeller parts.

Flight hardware of the glass fiber blade is to be delivered late next year. Experimental models have undergone tests in the laboratory at the company's facility in Windsor Locks, Conn. In tests to date, the lightweight blades have been subjected to vibration, damage from simulated flying objects, a two-day soaking in boiling water, high speed runs on a turbine engine and freezing to −65F. Simulated lightning and wind tunnel tests are scheduled for the near future.

"It's possible that there might be other uses for the glass fiber blade on other VTOL or STOL aircraft even before the tri-service transport is ready," a Hamilton Standard executive said. The firm has created a task force from its production plastics group to work with engineers on blade fabrication to come up with a design immediately adaptable to production.

The glass fiber blade is one of three propeller programs now under way at Hamilton Standard to develop high thrust, low weight propulsion for VTOL and STOL vehicles. The company also is working on an integral gear box propeller which places the gear train, normally mounted on the engine, on the propeller instead. Engineers believe the method might save



GLASS FIBER blades proposed by Hamilton Standard for tri-service VTOL transport propeller are readied for stress testing. Blades are fitted over steel spars attached to the hub.

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another 15% to 20% in weight. The third program is a variable camber propeller (AW Aug. 15, 1960, p. 98), which uses paired blades in a common hub to achieve maximum static thrust without sacrificing high speed cruise power.

Criteria Summary Awaited

Curtiss-Wright's Curtiss Division at Caldwell, N. J., has developed an all-glass fiber, low-cost radial lift propeller for V/STOL aircraft (AW June 20, 1960, p. 277; June 19, 1961, p. 93). However, a company spokesman said Curtiss-Wright will wait for Hiller's final criteria summary before deciding whether to make its bid with the propeller as now developed or with modifications.

The Curtiss-Wright propeller is an outgrowth of early glass fiber blades tested aboard the company's Models 100 and 200 VTOL executive aircraft. Basic structural material of the blade is a glass fiber weave with either unidirectional or bidirectional fiber orientation. The seamless monocoque blades are molded integrally with a steel blade root for hub attachment. The blades weigh about half as much as equivalent hollow steel or solid aluminum alloy types, according to the company.

Curtiss-Wright engineers maintain that the glass fiber blade offers several other advantages besides weight and cost reduction. They cite these benefits as control of mass and stress distribution by arrangement of material, low notch sensitivity, freedom from corrosion, high damping characteristics and reduced electrical power requirements for de-icing.

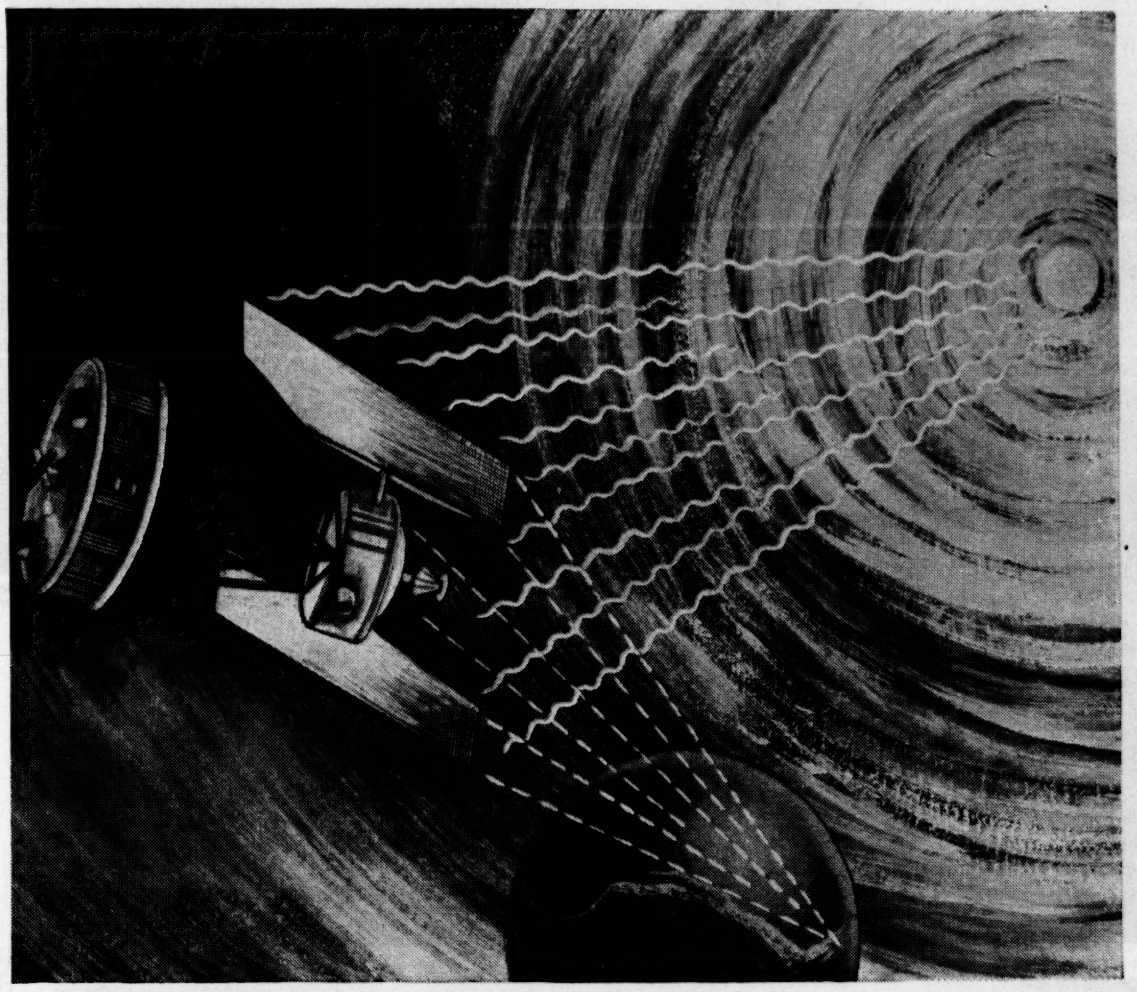
Intruder Completes Non-Refueled Flight

Grumman A2F-1 Intruder, twin-engine jet attack plane under development for the Navy, recently completed its first non-stop, non-refueled transcontinental flight, covering a 2,583-mi. course from North Island Naval Air Station at San Diego, Calif., to Grumman's Peconic River, N. Y., facility in approximately 4½ hr.

The aircraft, piloted by Lt. Cdr. Bud Ekas, clearance desk officer for Navy's Bureau of Weapons, used only fuel stored in internal cells. "There was a considerable fuel margin remaining when it landed," a Grumman official said.

The aircraft maintained 27,000 to 28,000 ft. altitude during most of the flight. Average speed was about 574 mph.

Eight flight models of the Intruder have been produced. A Navy preliminary evaluation of the plane's avionics systems will begin in a few weeks.



How to "air condition" solar cells in space

Bausch & Lomb optical/electronic/mechanical capabilities boost power-pack efficiency

Silicon solar cells provide energy for space craft by converting solar radiation into electricity. Only about 10% of the sun's energy is utilized. The rest is unwanted heat that can reduce the efficiency of the cells and jeopardize the vehicle's instrumentation.

Bausch & Lomb solar cell coatings, by selective absorption and reflection, enable the solar power pack to achieve optimum efficiency. (See typical curves.) Count on B&L experience—in vacuum deposition of precison coatings on all kinds of cover glass substrates as well as on the cells themselves—to tailor the coating to specific requirements.

Write for technical reports on B&L capabilities in design, development and production. Bausch & Lomb Incorporated, Military Products Division, 82124 Bausch Street, Rochester 2, New York.

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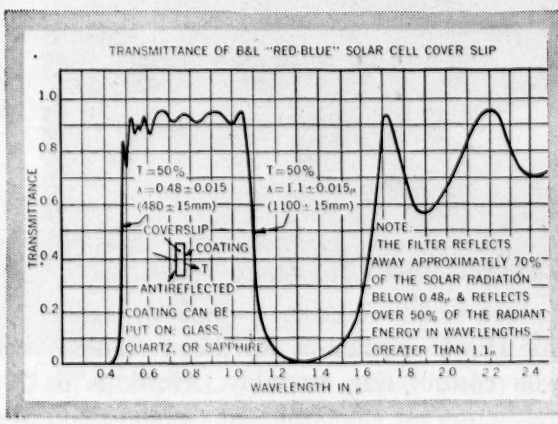
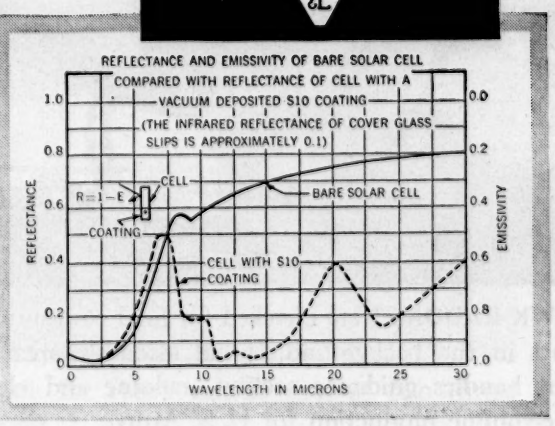
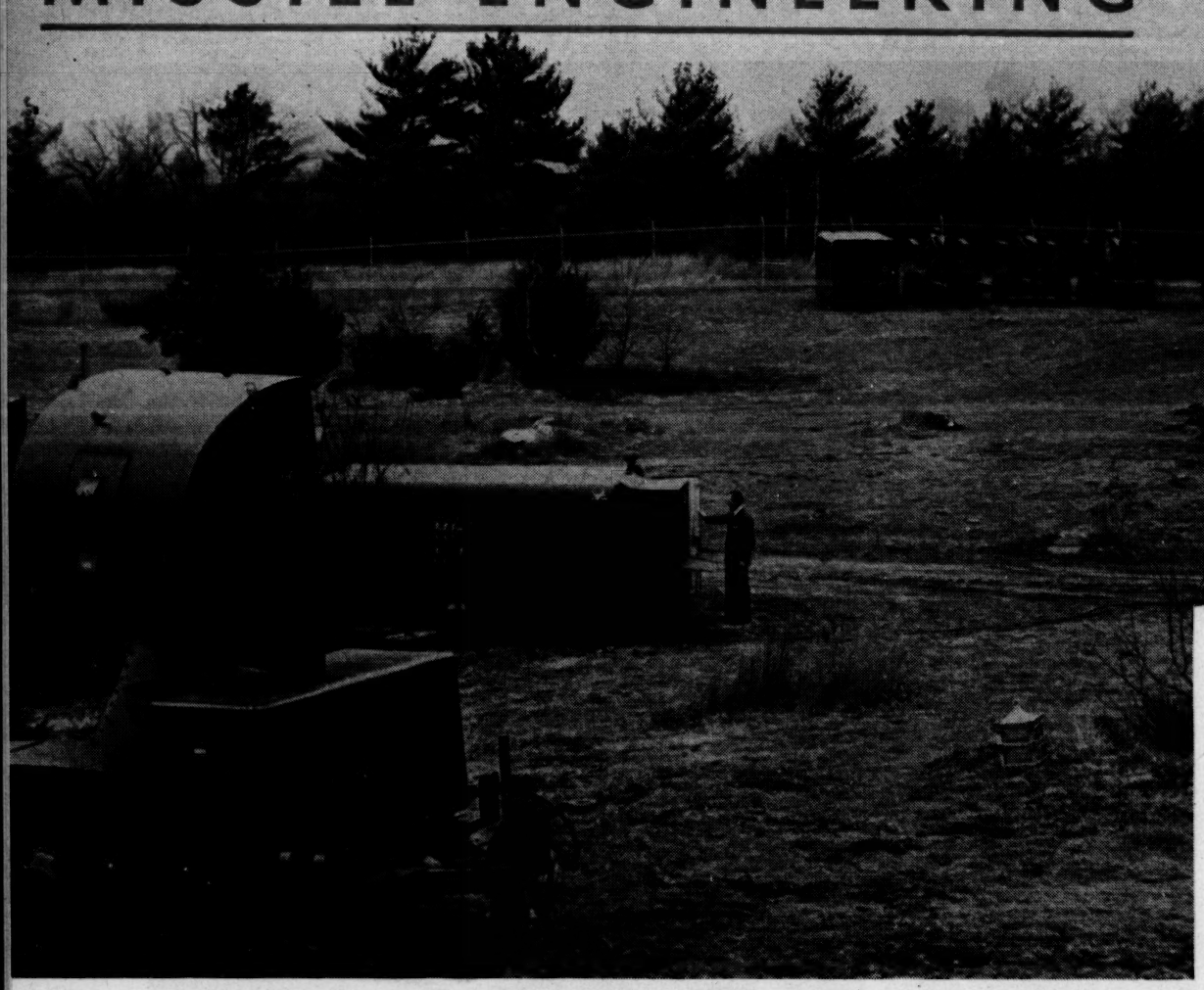
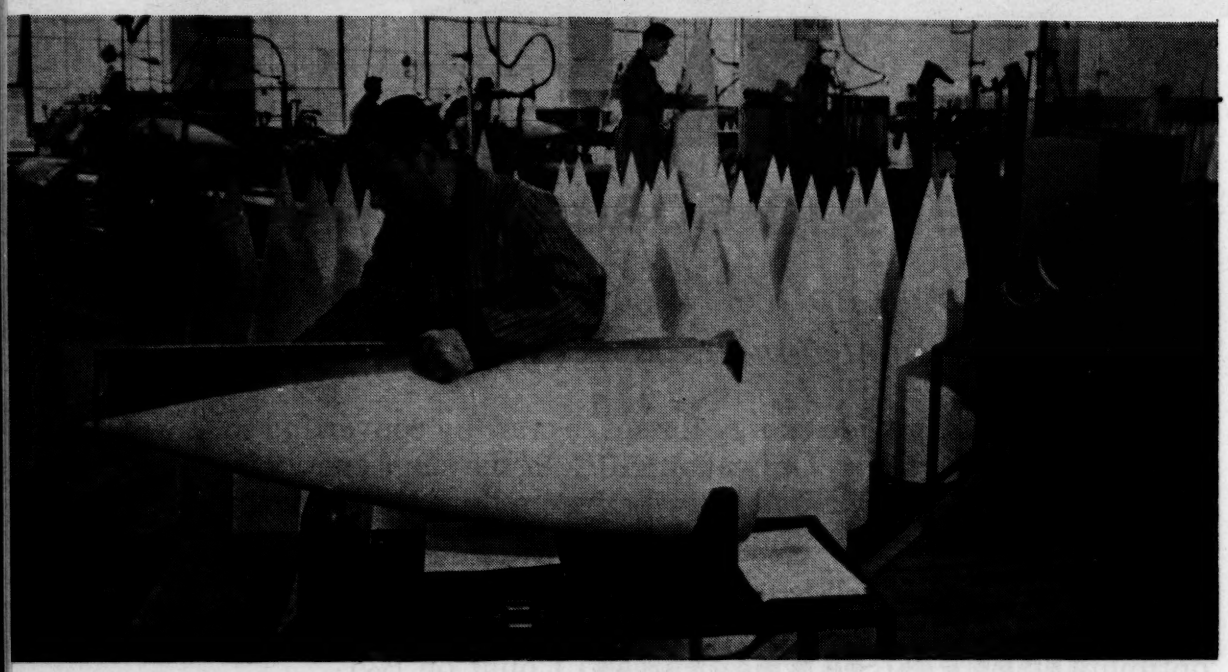
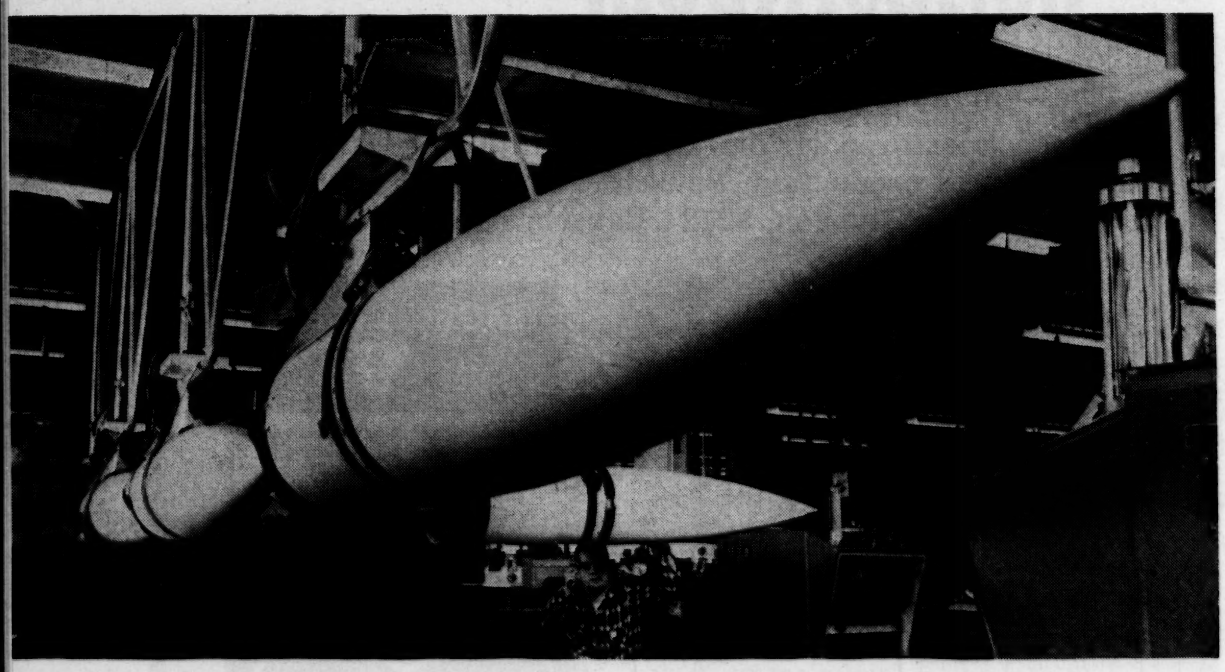






SIMULATED Hawk battery site aids development





HAWK RADOMES are checked for final contouring (above) before being finished on engine lathes in the background. Final assembly area for Hawk missiles at Raytheon Andover plant handles guidance section, radome and elevon control ring assembly. Hawk is in large-volume production for U. S. Army.

Hawk Anti-Aircraft Missile—

Production

By David A. Anderton

Andover, Mass.—Raytheon Hawk missile system, continuing at peak production level for the U. S. Army, draws on more than 3,500 active suppliers of parts in a program whose costs since inception are climbing toward the $900-million mark.

More than half these allocated funds have been spent outside the company, Raytheon says, and about $200 million have gone to the many small businesses associated with the Hawk project.

Raytheon has had more than 5,200 direct suppliers to the program to date. Including all sub-contractors, the company estimates the total number of manufacturing firms associated with the Hawk at a "conservative" 25,000.

As prime contractor for Hawk to Army through the Boston Ordnance District, Raytheon Co. has systems responsibility for the missile. Technical direction of the project is in the hands of the Army Rocket and Guided Missile Agency at Redstone Arsenal, Huntsville, Ala.

Systems engineering in the research and development sense, plus flight test work on complete systems, is under Raytheon Missile Systems Division at Bedford, Mass. Work on continuous wave and pulse acquisition radars was done by the company's Equipment Division at Wayland, Mass. Production of the system is the responsibility of Aero/ Weapons Division here.

First exclusive details and photographs of the Hawk system appeared in AVIATION WEEK Dec. 4, p. 74, as the first article of this two-part series.

Raytheon management adapted most of the standard approaches of large-scale, complex-system production to the Hawk. It should be pointed out that Raytheon is not in a strange field;

g of missile system. Engineer enters battery control central (left); cw acquisition radar is in left foreground.

rt II:

ace for Hawk Is Set by Quality Control

although traditionally associated with the manufacture of electronic equipment, the company has versatile manufacturing capability across the spectrum. In addition, Raytheon is prime contractor to the Navy on the Sparrow 3 air-to-air missile, a weapon of a different sort but involving many of the same approaches in design, engineering and manufacturing philosophies.

The company relies heavily on subcontractors and suppliers of parts and hardware. In the Hawk missile there are about 3,500 separate parts of about 1,500 different kinds. Only 113 of these are made by Raytheon; the rest are purchased outside the company. Including raw materials, more than $6.5 million worth of purchased parts comes in every month for Hawk.

Parts with a high direct-labor cost are, in general, manufactured by Raytheon.

Peak production scheduling is based on one-shift operation, with some second-shift time for maintenance and to fill in at trouble spots. This gives flexibility for any sudden need for extra production; by adding a full second and third shift, Hawk output could be nearly doubled or trebled.

Raytheon managers talk about two basic manufacturing philosophies which they apply to the Hawk:

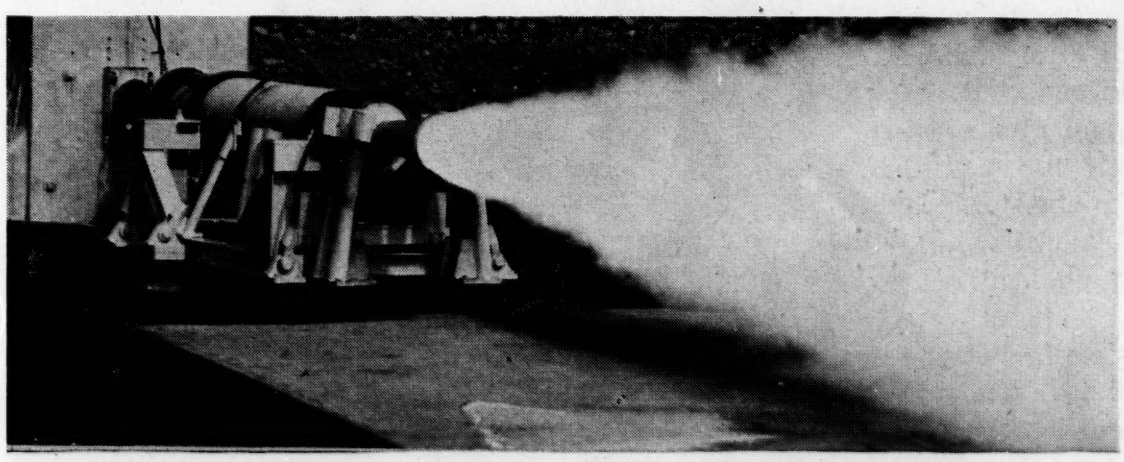
- **Versatility,** so that changes or modifications can be put into production missiles as rapidly as possible, without dependence on a vendor's lead time.
- **Capability,** so that every critical part in the system could be manufactured, if necessary, by the company. This eliminates long line shutdowns if a subcontractor runs into trouble.

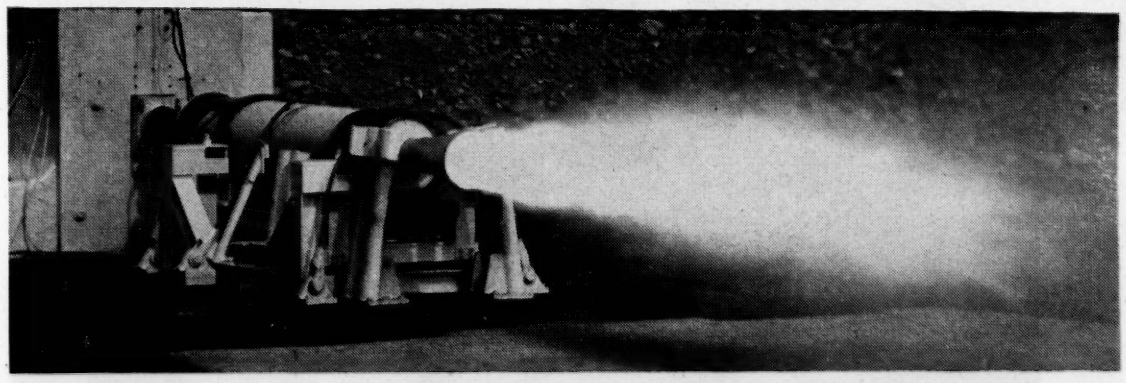
But most impressive to the engineering observer is Raytheon's insistence on the importance of quality control, and the elevation of quality control engineering to a position just below top plant management. This change from the usual scheme of things was born out of the Hawk program and, according to company officials, is a major factor in obtaining and keeping a high rate of delivery of complete systems.

The quality control system starts at a shop level when any purchased part arrives at the Raytheon plant here. More than 250 inspectors in three areas —mechanical, electrical and microwave —augmented by Army Ordnance inspectors check almost everything as if it were to go on a flight missile. In spite of the quantities of materials involved, there is very little sampling; almost 100% testing is done on incoming parts. They are put through drop, shake, shock and life-cycle testing before being released to production.

At an engineering level, quality control starts with personnel from the group in research and development engineering offices at Bedford. From initial design to final delivery, they are never far out of sight of every part that makes up the Hawk system.

A major share of the quality control job is assigned to its engineering department which is responsible for a variety of jobs usually assigned to many different engineering groups. For example, quality control engineers develop all functional system parameters to define the limits of operation. They develop all test procedures and tell both production test and quality control test per-





AEROJET-GENERAL solid-propellant rocket engine for Hawk missile fires at two thrust levels: boost (above) and sustaining for cruise (below).

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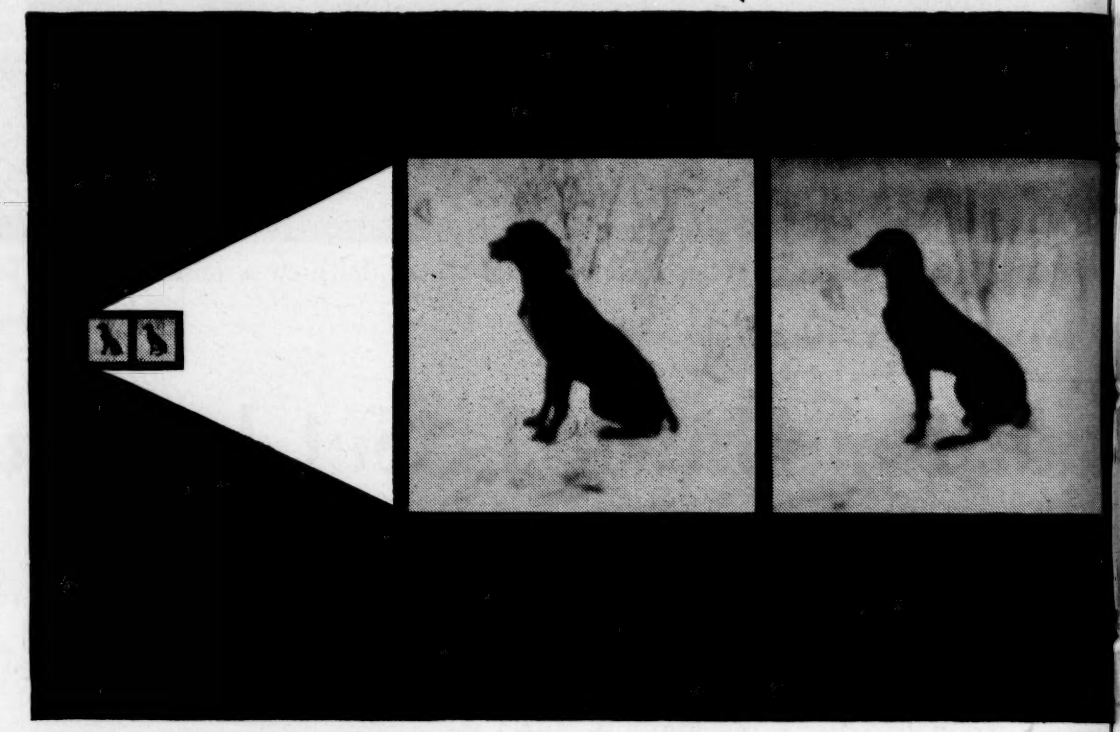
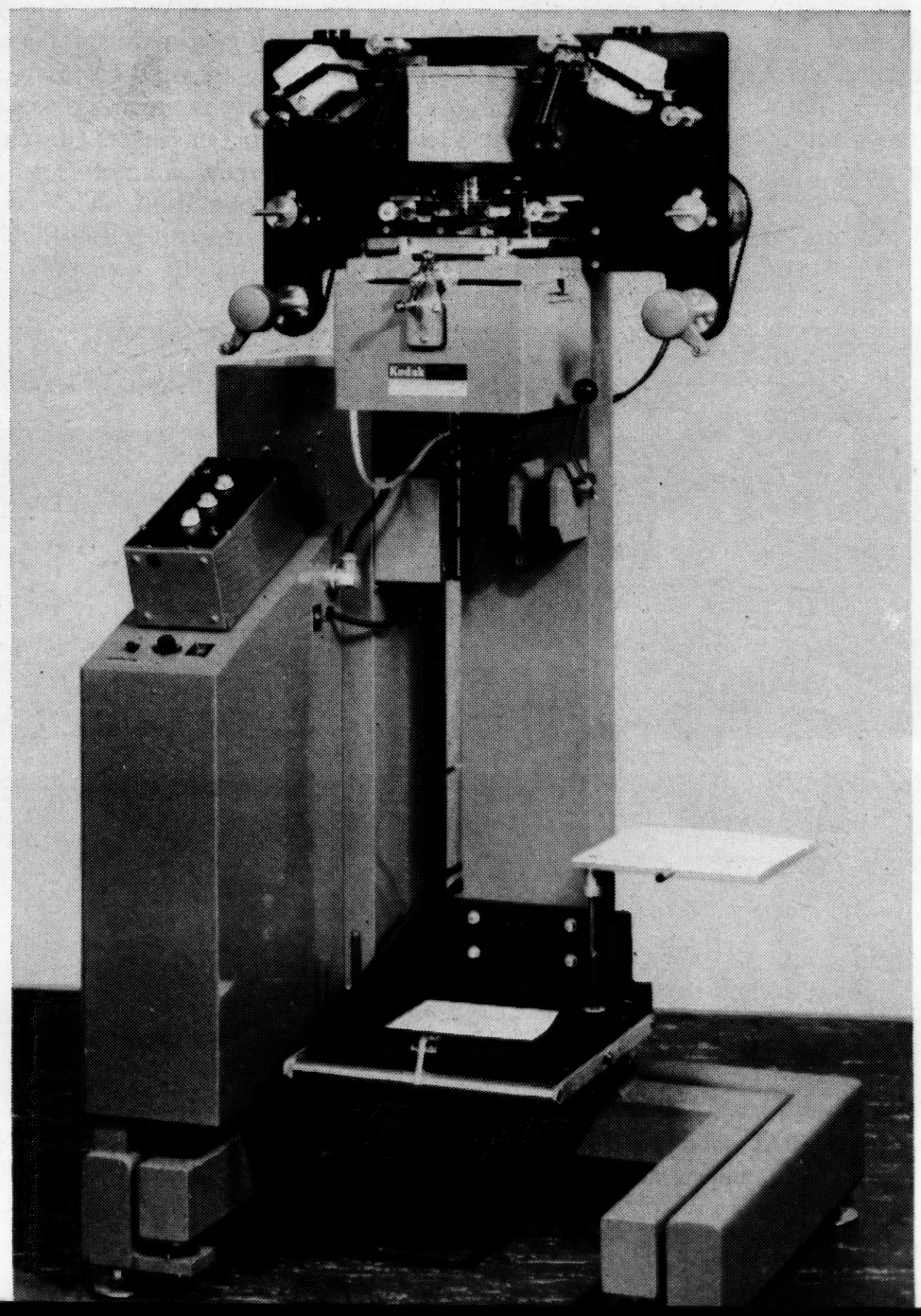
Kodak hi-fi for



Is this a picture of two inanimate objects? "*No.*"
Is this a picture of two animals? "*Yes.*"
Are they large animals? "*No.*"
Two-legged animals? "*No.*"
Are they feline? "*No.*"
Dogs? "*Yes.*"
Longhair dogs? "*No.*"
Is one a German Shorthair dog? "*Yes.*"
Is the other? "*No.*"

And now a message from the sponsor:



The uninitiated have now been initiated in didactically rudimentary fashion in the spirit with which the piece of equipment pictured at the left digs out, *bit by bit*, information of real consequence provided by an ambitious photographic system.

The item was custom-built by the Kodak *force in being*, which modestly calls it a 20X precision enlarger. The item is not stocked for sale.

All this enlarger does is: 1) remove dust and static charges from the film, 2) project the film while it is submerged in a liquid of matching refractive index, 3) insulate the film from vibration, 4) resolve 200 lines per millimeter to the edge of the picture and more than 400 lines in the center.

This is not a "breakthrough" in enlargers as we understand the term. But it is, we hope, the best enlarger in the world.

It is as good as it is for the simple and undramatic reason that a new method of optical analysis now provides a clearer insight into these matters. We now know that the term "resolving power" doesn't describe fully enough the ability of an element in a photographic system to handle fine detail. The perform-

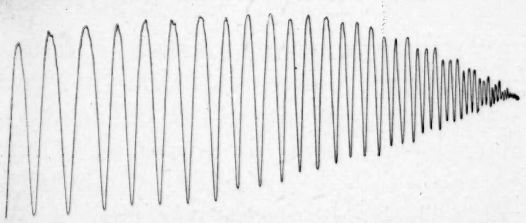
photographic systems

ance of the enlarger shows the practical worth of some theories we have had wherein the term "resolving power" is replaced by a more revealing concept from the electrical engineer's vocabulary — "sine-wave frequency response."

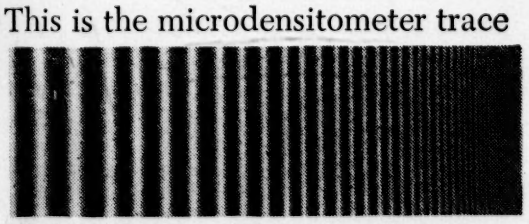
Can you imagine treating a photographic lens or a photographic emulsion, or a combination of the two, as though it were an a-c system and developing equations for its sine-wave frequency response? That's exactly what we are doing.

At right is pictured one of the practical tools we are doing it with.

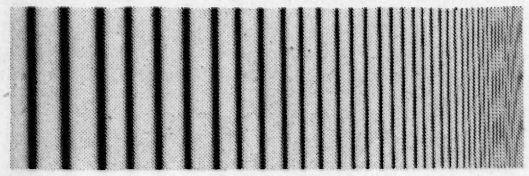
It is a microdensitometer we built to measure details in a photographic image down to 0.00005 inch.



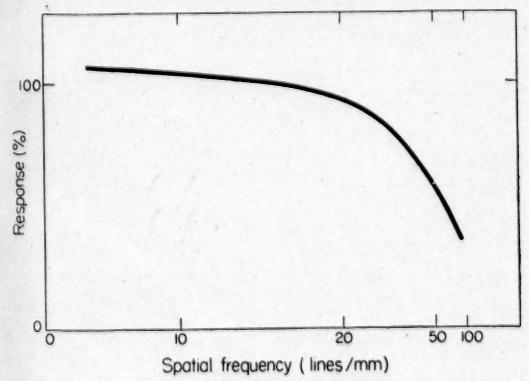
This is the microdensitometer trace



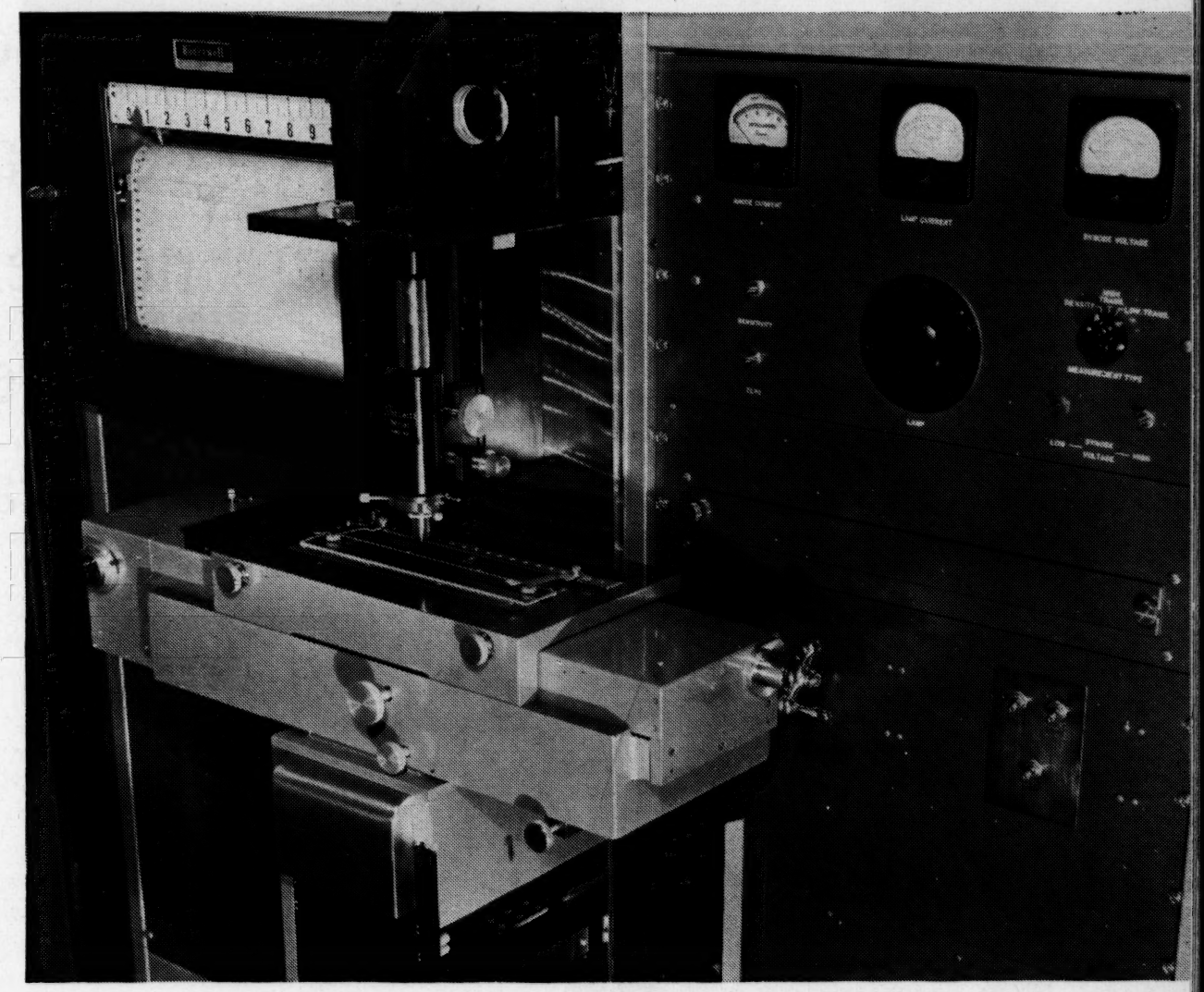
of this photographic reproduction



of this sine-wave test object.



And here we have plotted the relative amplitude of the above photographic reproduction as a function of spatial frequency. This is the "sine-wave frequency response" of the photographic system.



Could it be we've hit on a common denominator, a common language for photographic-emulsion men, lens men, and electronics men?

Is it possible to apply the same Kodak-engendered theoretical models and practical tools to the optical, mechanical, and photographic-emulsion elements of a photographic system, *plus the electrical elements, if any?*

And if we do, does it become possible to predict the ability of the total system to reproduce detail in terms of signal-to-noise ratio in the final big picture?

Yes, on all three counts. We submit the work of our 20X precision enlarger as exhibit "A."

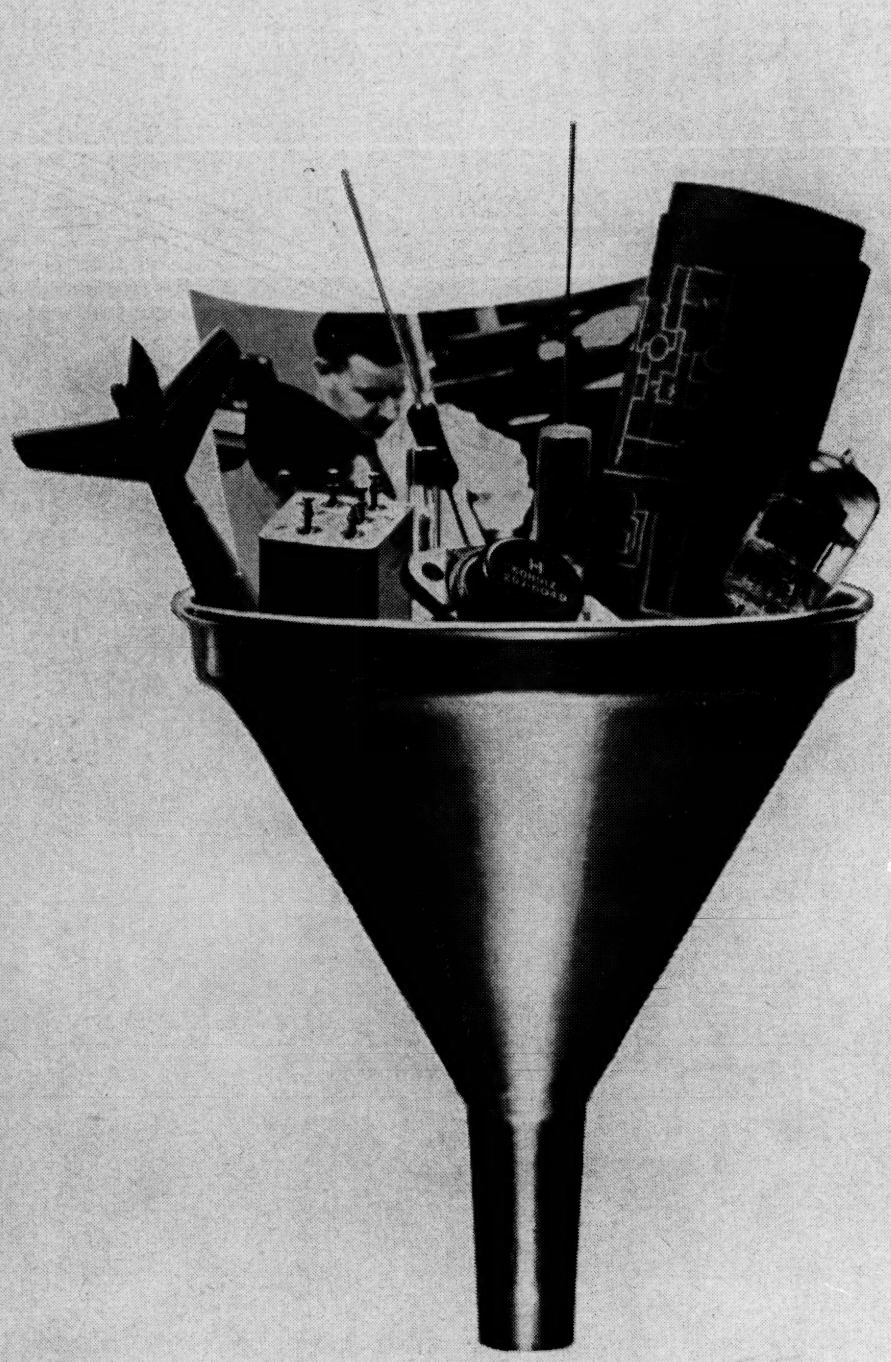
Before you call us in to build a total photographic system based on these principles, you might wish to write for a review paper by one of our men whom we have kept busy for many years combing out the principles. Its title: "Methods of Appraising Photographic Systems." It is not so simple as this advertisement.

On the other hand, we've already read the paper, so if you'd like to get started . . . *shall we meet and talk about the connection between our capabilities and your problems?*

PHOTOGRAPHY
OPTICS
ELECTRONICS
MECHANICS
INFRARED

For the above-mentioned paper and the new booklet, *Kodak/ a Force in Being,* that summarizes our work in coordinating these fields, write Government Contracts Department,

EASTMAN KODAK COMPANY, *Apparatus and Optical Division, Rochester 4, N. Y.*

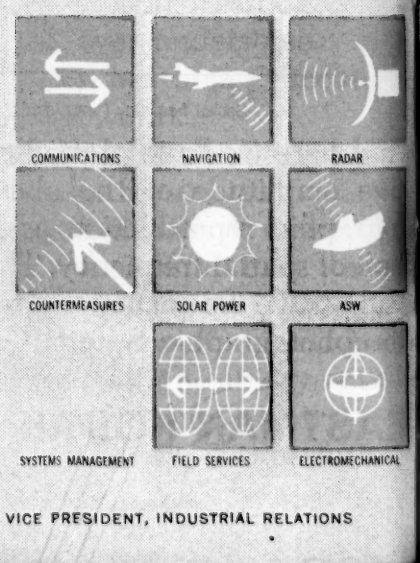


Hoffman, pioneer in TEAM contracting, now experienced in three major programs...

ULD-1
480-L
DCCS

In 1957, in conjunction with the U. S. Air Force, Hoffman implemented the idea of a co-contractor, systems management team relationship for the ULD-1 Program. This involves the development of a system by many co-contractors under the guidance and direction of the Hoffman Systems Management Department. Basic experience in such cooperative efforts was acquired by Hoffman's management of the team producing the Air Force's ULD-1 (Tall Tom) System. The ability to integrate its contributions with those of other organizations is demonstrated by Hoffman's participation as a team member in projects 480-L (AIRCOM), the Air Force's World-Wide Communications System and DCCS, DCA's Defense Communications Control System.

Experience, knowledge and skill provide Hoffman with a unique capability in systems management.



Hoffman / ELECTRONICS CORPORATION
Military Products Division
3740 S. Grand Avenue, Los Angeles 7, California

SIGNIFICANT DEVELOPMENTS AT HOFFMAN HAVE CREATED POSITIONS FOR SCIENTISTS AND ENGINEERS OF HIGH CALIBER. PLEASE ADDRESS INQUIRIES TO VICE PRESIDENT, INDUSTRIAL RELATIONS

sonnel just how those tests will be run.

The group also designs and develops the equipment to make the tests in the first place, and then is responsible for documenting those tests for the customer. Maintenance and calibration of all test equipment is also under the quality control group.

Only two Raytheon managers have the authority to stop the Hawk production line: one is the Andover plant manager and the other is the chief quality control manager. There is no time wasted in the action, either. One engineer remembered a time when some trouble developed in production of the Hawk. It was reported by the line foreman to the responsible quality control engineer who in turn went to the manager with the story. "We shut the line down in 10 minutes' elapsed time from the discovery of the trouble," the engineer pointed out.

This kind of decision-making machinery in the hands of quality control personnel is unusual. But the company says it pays off in many ways that would be difficult to achieve otherwise.

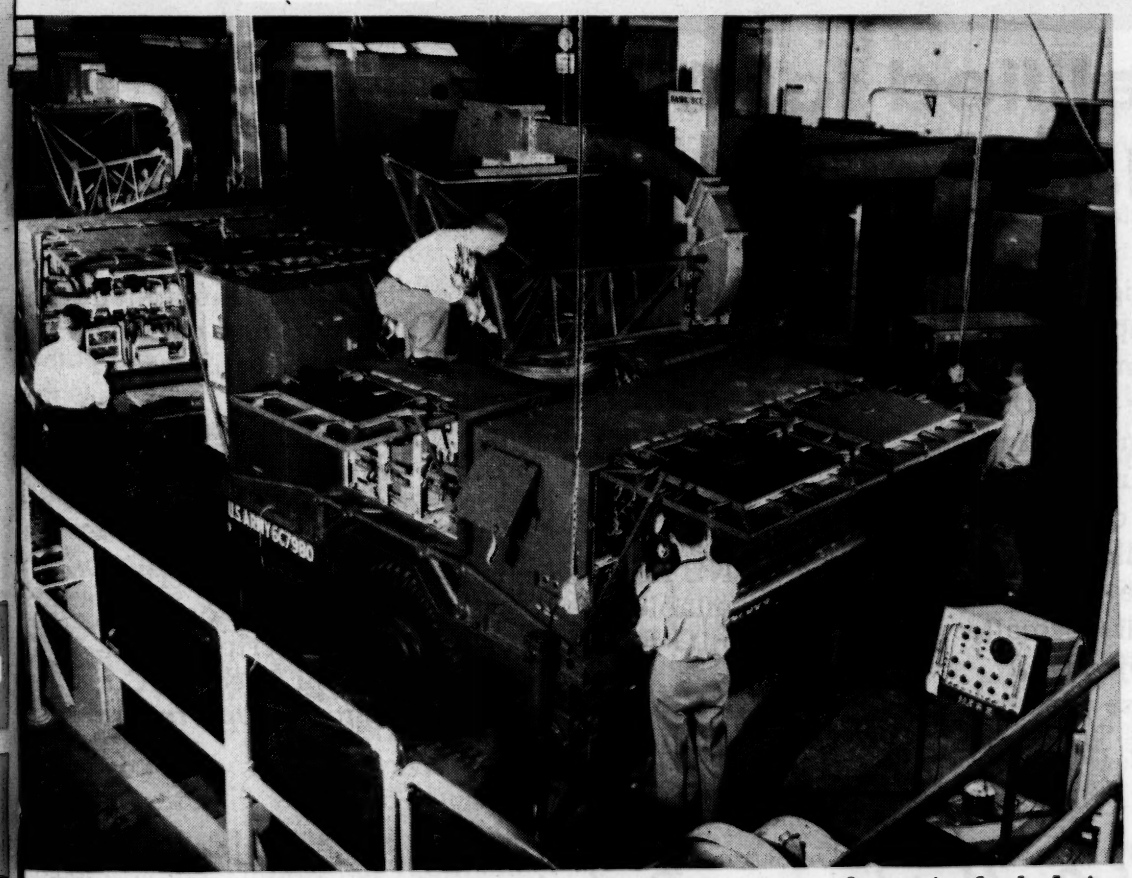
Once the line has been stopped for cause, the quality control manager gets systems engineers to dig into the difficulty. When the problem is solved, there is a routine procedure involving Army Ordnance permission that has to be completed before the line can start again. The reason involves contractual obligations.

If a part has to be changed, that means the contract also must change, and Army must have full knowledge of the proposed changes before they can be incorporated. So Raytheon quality control engineers test the new change or new part, document that test and report it to the local representative of Army Rocket and Guided Missile Agency. If he approves, he forwards the report to the Contracting Officer of Boston Ordnance District, who has the authority to tell Raytheon to get going again. There is no way of short-circuiting this procedure to speed up production, except of course by hand-carrying documents through the channels instead of sending them by mail.

One detail of the change system is worth noting. Even the EO (Engineering Order) forms, which are generally used to make small changes on a production drawing and which eliminate the need to correct the main drawing every time there is a small change, follow tight procedures. They have a space for the dates on which repair parts will be available and on which technical manual pages will be ready. There is no EO sent out without this information, so that there should never be a case of a missile arriving in the field when the troops don't have the necessary information in drawings or documents, or parts to complete it.

Finally, when a missile system is ready for delivery, quality control signs the final certificate of inspection. Units are still subject to a further check at the option of the Boston Ordnance District. Their inspectors can ask for spot checks of warehoused items in a so-called Verification Test. With these out of the way, the missile is released to Army channels.

Raytheon's work on the Hawk system in production is divided about



AN/MPQ-35 pulse acquisition radar for Hawk missile system gets electronic check during final assembly at Raytheon's Waltham plant. Dummy load replaces paraboloid antenna on top of palletized radar assembly. Unit is wheeled for over-the-road towing, breaks into two sections for helicopter transport.

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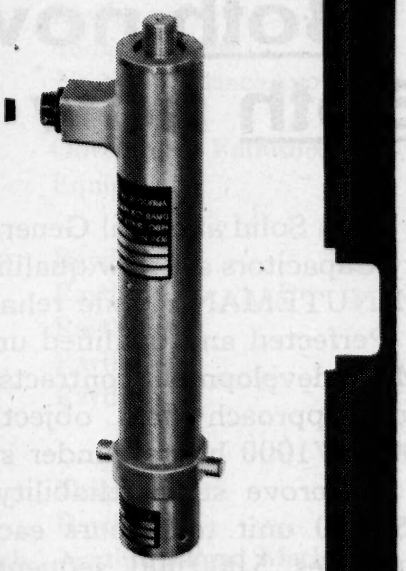

FOR TECHNICAL DATA on RPI propellant-powered actuators, write for Technical Bulletin #1100.

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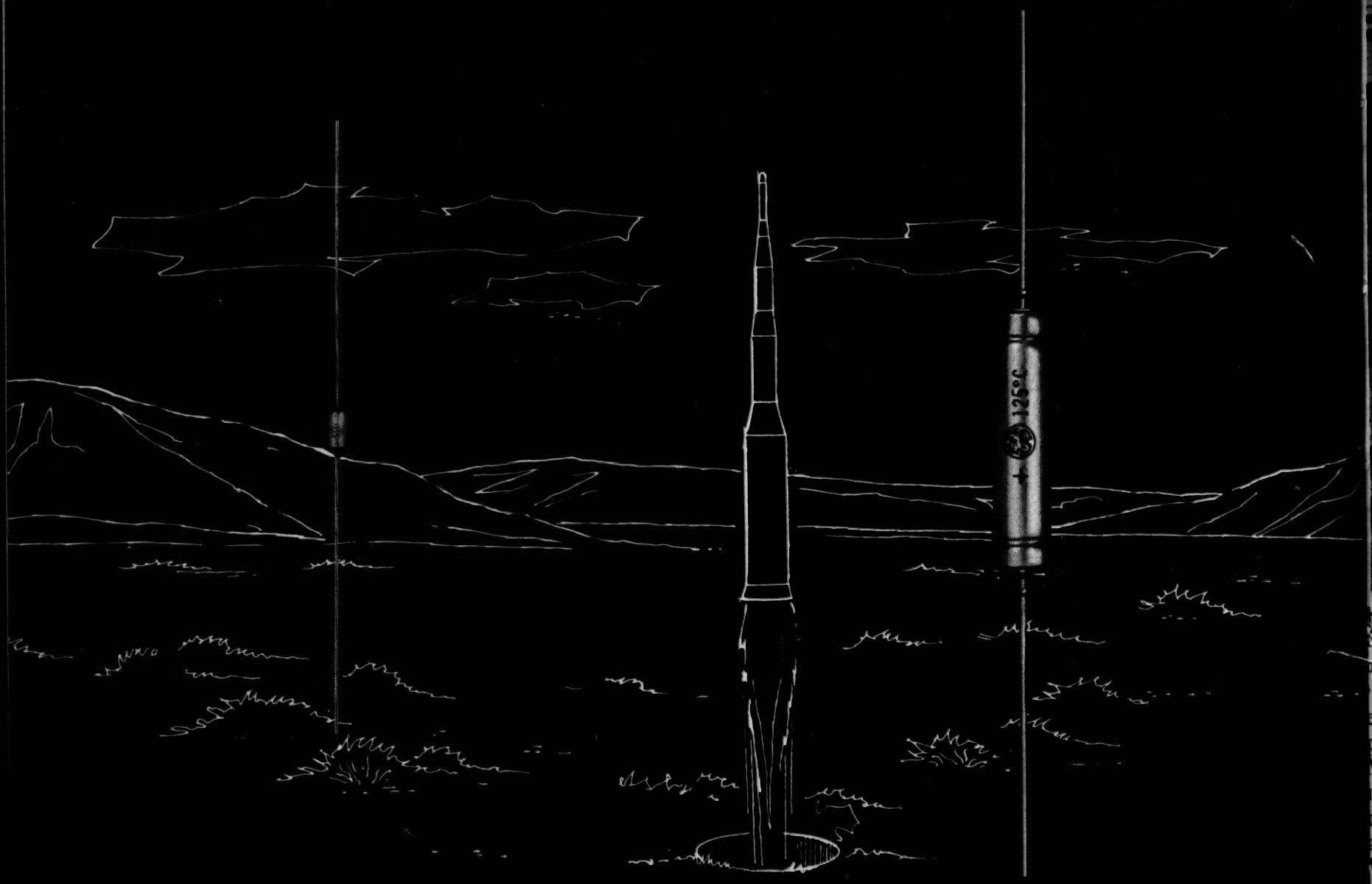

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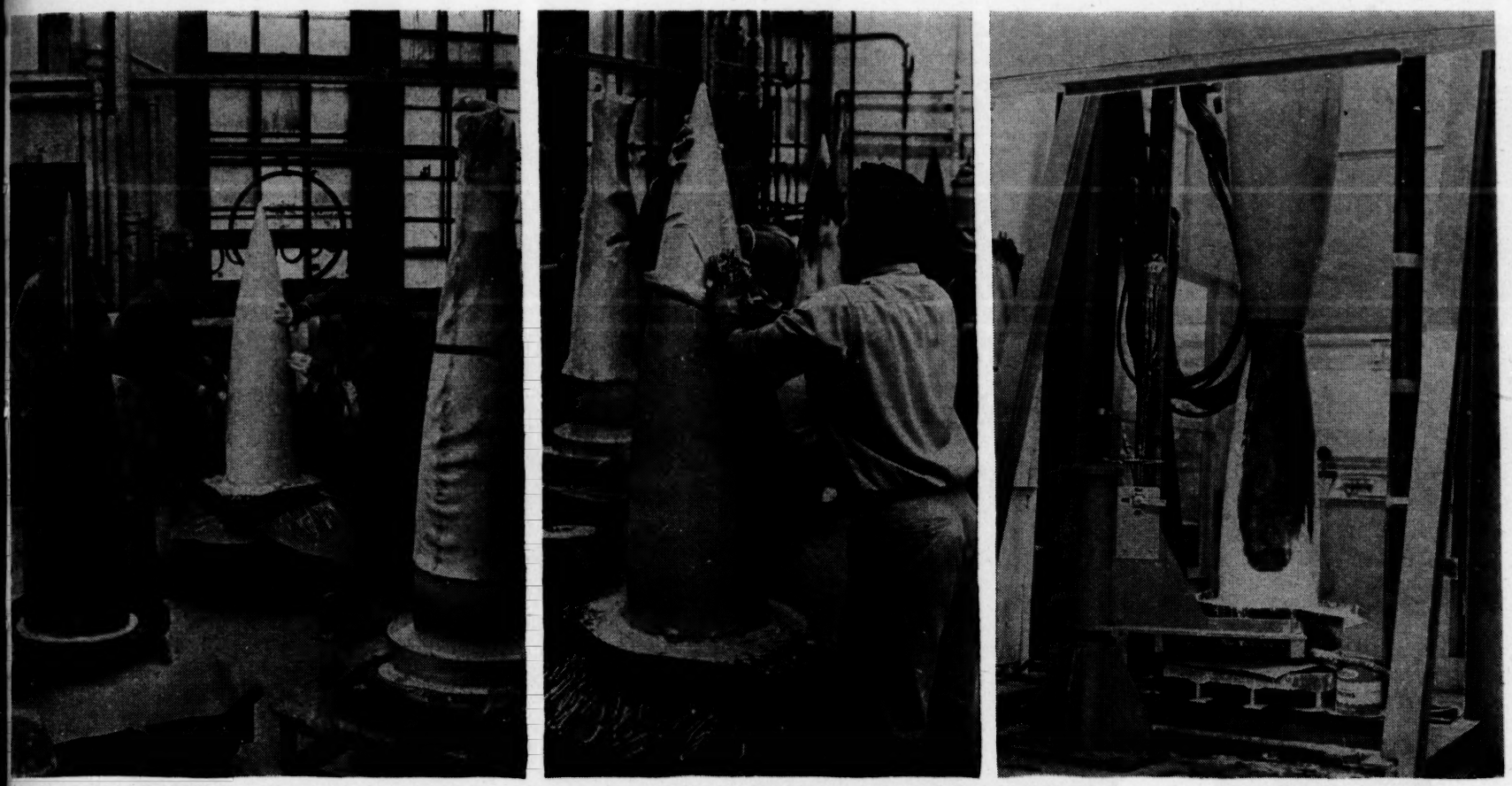

HAWK RADOME is made from layup of 28 glass cloth "socks" pulled over a steel form and hand-worked to eliminate wrinkles and impregnate the cloth. Final step is forcing excess binder out with Hydrosqueegee and curing the layup with heated rubber bag drawn over the built-up form. Cycle takes about one hour per radome.

equally between the 1.2-million-sq.-ft. plant here and the Waltham plant. Most of the parts associated with the missile airframe—guidance system, radome, and final assembly of the nose and tail packages—are handled here. Waltham is responsible for heavy equipment production such as the battery control central and the ground radars.

A tour of the factory shows that the aims of manufacturing management—versatility and capability—seem to have been carried out. The machinery is varied in size and function; there are no endless ranks of the one-type machines usually found in high-volume machine shops. Instead there seems to be one each of every type and size of machine tool, giving the observer the impression of a large experimental or prototype shop rather than a gear works.

The other noticeable feature of a factory tour is the large number of quality-control stations. The over-all factory average works out to about one quality control man per seven workers; their positions are dotted all over the factory floor. In the section where deft-fingered women fabricate the complicated guidance "platters," every few stations along the line is an inspection position, where the work of the previous few operators is carefully checked and verified.

Actual rate or quantity of Hawk production is not known; but the number of components stored waiting to go on final assembly confirms the impression that this is one of the largest missile production jobs in the industry. Everywhere the observer looks in the factory he sees rows of radomes, scores of guidance sections waiting for test and calibration, dozens more under test in a series of alcoves and cells.

Finally all the parts come together in one of the shortest production lines yet seen. This relatively small area, tucked away in one corner of the plant, takes the guidance package with its seeker head, covers it with the radome, adds the elevon control ring and package, and sends it out to final checking.

Most of the production techniques are straightforward. Hawk is meant to

Hawk Missile System Suppliers

Item	R&D	Production
Hawk missile:		
Guidance	Raytheon	Raytheon
Powerplant	Aerojet-General	Aerojet-General
Wings, elevons	Northrop	Northrop/Temco (now L-T-V)
Warhead	Picatinny Arsenal	Government Furnished Equipment
Ground guidance group:		
Battery control central	Raytheon	Raytheon
CW acquisition radar	Raytheon	Raytheon
CW illuminator	Raytheon	Raytheon
Pulse acquisition radar	Raytheon	Raytheon
Assault fire command console	Raytheon	Raytheon
Ground support equipment:		
Launcher	Northrop	Northrop
Launcher electronics	Raytheon	Raytheon
Loader/transporter	Northrop/Food Mach.	Northrop/Food Mach.
Pallet	Fruehauf	Fruehauf/Portland Copper & Tank
Guidance container	Applied Design	Williamson Mfg. Co.
Single tactical container	Applied Design	Williamson Mfg. Co.
Test equipment:		
Missile test shop	Raytheon	Raytheon
Ground equipment test shop	Raytheon	Raytheon/G. F. E.
Shelters	Craig	Craig
Electronic test equipment	Raytheon/RCA	Raytheon/RCA
Hydraulic-mechanical test equip.	Raytheon/Kidde	Raytheon/Kidde

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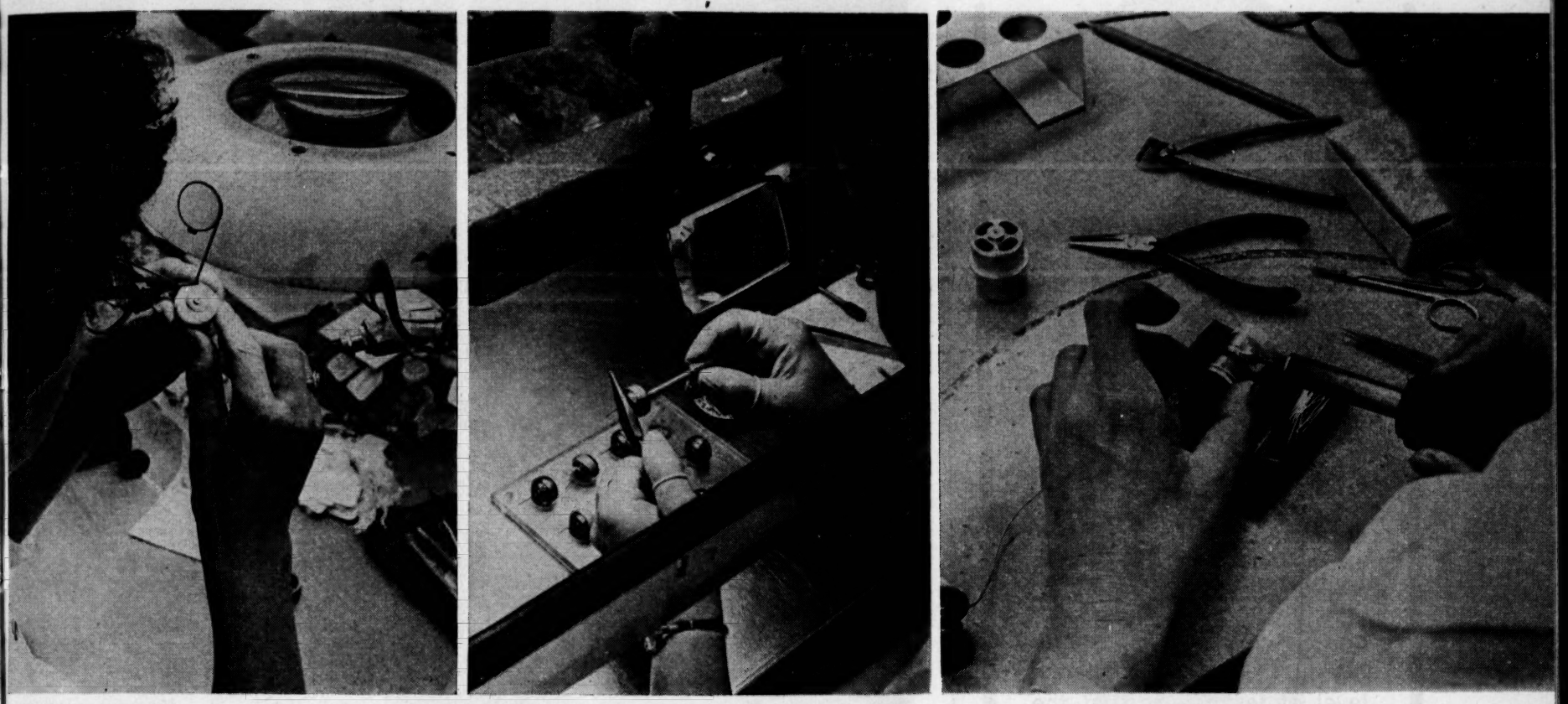

HAWK GYROS and accelerometers are assembled in a clean room at Raytheon's Andover plant. Production techniques are conventional; accent is on quality control and careful inspection following every few steps of assembly.

be a rugged missile built to withstand the rigors of Army operation and to be easily repairable or maintainable in the field. This in many ways dictates an unsophisticated design using minimums of exotic materials or fabrication methods.

But a few of the production techniques used are somewhat different. One of these is the production of the glass fiber radome that covers the seeker head and forms the aerodynamic fairing for the front of the Hawk missile.

Radome Production

The glass fiber layup that finally emerges as a finished radome for the Hawk starts in Raytheon shops as 28 "socks"—patterned and sewed glass cloth formed into shapes approximating that of the radome—pulled on a metal form.

Two men work at each mandrel, pulling the tight-fitting "socks" down over the contoured mold form, smearing the creamy curing plastic over each layer and working out the wrinkles with their gloved hands.

With the rough layup completed and covered with a polyvinyl chloride sheet, the mandrel is positioned in a Hydrosqueegee, the shop name for a fixture which squeezes out the excess binder, smoothes the wrinkles in the "socks" and cures the piece in one operation that lasts about one hour. The Hydrosqueegee is a hot-water-filled conical bag of rubber suspended from an overhead support. The work piece is located so that it and the bag are point-to-point in the vertical position, like two radomes nose to nose. The bag is then lowered slowly over the form, and the hydraulic pressure of the water inside the bag squeezes out the excess binder as the bag slowly lowers to cover the entire radome layup. It goes on like a "sock," put on inside out and starting at the point of the radome nose.

After curing, the nose radomes are routed to a machine shop for final contouring on a lathe with an automatic tracer to meet minimum tolerances.

Finally each radome is checked electronically to determine its dielectric properties before being routed to final assembly for installation on the guidance package.

Raytheon makes the rate gyroscopes and accelerometers used in the Hawk's internal guidance package. Production techniques are conventional; work is done in the usual "clean" room, largely by women workers and inspectors.

Production Techniques

The gyro starts out as a motor stator, around which is the rotor which doubles as the inertia flywheel of the gyro. The rotor-stator combination is gimbal-mounted, then pickoffs—which have been made as a separate assembly—are added. Finally the case seals off the gyro assembly.

Gyro and accelerometers are on the order of two inches long and about one inch in diameter.

The insistence on quality control, prevalent throughout Raytheon Hawk manufacture, is almost the dominant factor in gyro production. One estimate by an engineer is that money spent on inspecting and testing of gyros is as much as that spent on their production.

Most of the elements of a field battery are sprawled out on a few acres of rolling terrain a short drive from the Raytheon plant here. At least one unit of each operational type is in working condition and is used almost continually in a severe test of Hawk capabilities.

Hawk rounds stand out in the open, snowed on in winter and sunburned in summer, as working missiles to be carried from supply point to a launcher, tested and checked either alone or as part of a system, and then taken back to storage again. Some of the Hawks show handling marks, their paint has been chipped and the steel has rusted; but on the launcher they behave just like new missiles off the factory line under test.

Air traffic in the pattern for Boston's Logan Airport and Raytheon test aircraft based at USAF's Hanscom Field in nearby Bedford furnish practice targets for Hawk acquisition and illuminating radars.

This field site serves several purposes:

- **New developments in the Hawk** system can be checked here in a simulated operational environment.
- **Updated installations** or modifications originating in field service reports can be checked for performance.
- **Training of key NATO personnel** is done here.
- **Trouble reports from field** service representatives pass through the test site for solution, if a field-level solution is indicated.

Hawk History

Raytheon's initial work in the missile field began near the end of World War II when the company's engineers were developing a target-seeking system for the Navy's Lark anti-aircraft missile, then being built in parallel programs by both Consolidated-Vultee Aircraft Corp. (now General Dynamics) and the

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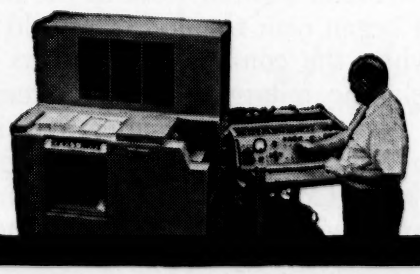

ENVIRONMENTAL TEST of Hawk missile airframe is one of rigorous set of checks ma on system components during manufacture.

Ranger-Lark division of Fairchild Engine and Airplane Corp. (now Fairchild Stratos Corp.).

From this program came an active cw radar seeker, and later a pulse seeker which Raytheon wanted to fly in a General Dynamics Lark airframe. But the Lark program, like many others in the early postwar proliferation of projects, was cut back and Consolidated-Vultee's portion was canceled.

But there were some spare Lark airframes around, and Raytheon got some, installed the company's pulse-radar seeker and added a mid-course guidance system, thus replacing the original beam-riding system that guided the Lark.

First target intercept with the Raytheon system in the Lark airframe was made in January, 1951. Shortly after that, the Navy's Bureau of Aeronautics directed the work toward a semi-active system to increase effective range.

The experience gained in working in the various phases of the Lark program led directly to the Raytheon prime contract on the Navy's Sparrow 3 air-to-air missile. While that system was being developed, the Army evolved a missile requirement for defense against low-altitude targets.

From Army Ordnance Corps, Raytheon received a contract to develop a ground-based illuminating radar to go with an unchosen low-altitude missile system using cw radar techniques. Parallel with this task were a number of other study contracts placed with industry and intended to lead to the low-altitude defense missile system.

Raytheon decided to risk a compar funded proposal and submitted an u solicited design for a complete miss system to Army. In July, 1954, Arm told Raytheon the contract was thei one year later, the Army asked for year's acceleration of the program. 1956, there was a further acceleratio in the program when Army asked Ra theon to increase system capabilit and still maintain the same delive schedules.

In 1956, technicians fired the fi Hawk against a target. It was the fi flight with a full guidance system op ating and it was the first target int cept for Hawk.

During subsequent test flights, Hav missiles have been fired against lo flying, high subsonic speed drones li the Lockheed QF-80, against the Co poral tactical ballistic missile, and t Honest John and Little John heavy a tillery rockets. In all cases the closu speeds were supersonic, varying fro below Mach 2 to well above Mach The missiles also presented a consid ably smaller radar target for the Hav system than conventional target dron Little John, for example, is just over foot in diameter and is actually small than the Hawk itself.

In some quarters this kind of pe formance has been equated enthusia tically with anti-missile capabilities f the Hawk. But Raytheon engineers a the first to point out that this is n universally true. Anti-missile capabi ties are inherent in the missile syste they say, but obviously there is a gre deal of difference between being ab

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This requires the application of creativity and technical experience by engineers, mathematicians and physicists. To our recently organized Development Division we seek to add *Development Specialists* with at least six years' association with large projects. They will evolve requirements for systems users, working in such areas as air traffic control, ASW, satellite control and command and control systems, and in such projects as information retrieval, man/machine communications and advanced computer utilization.

Digital Equipment Engineers are needed to translate systems requirements into system hardware. We seek E.E.'s with at least five years' experience to work in such areas as logical design; core, drum and tape memories; peripheral equipment; and large-scale switching center techniques.

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to kill a short-range, relatively slow battlefield ballistic missile or artillery rocket and being able to stop a hypersonic ICBM.

They'd be willing to tackle the former, but defense against ICBMs is a long way beyond the Hawk system.

As an over-all program, Hawk ranks among the few really high-volume production missiles ever to be built. It has reached out through extensive subcontracting to thousands of small firms throughout the world. It is now on station in dozens of batteries in the U. S., the Panama Canal Zone, Western Germany with the U. S. Army, and the islands around Okinawa. The U. S. Marine Corps has adopted the Hawk system for defense against enemy air during their vertical envelopment assaults. Within months it will be adding significant strength to the defense of five NATO countries in Western Europe.

"We're still a first-line battlefield weapon," said one engineer. "Even in the days of massive retaliation, Army kept this program going. Lately we've had ample proof that the kind of threat we designed against still plays a large part in the enemy's offensive power. We expect that that threat, plus the capability of the Hawk system in limited wars or the special problems the Marines may have to face, will keep us in the Army inventory for quite a while."

PRODUCTION BRIEFING

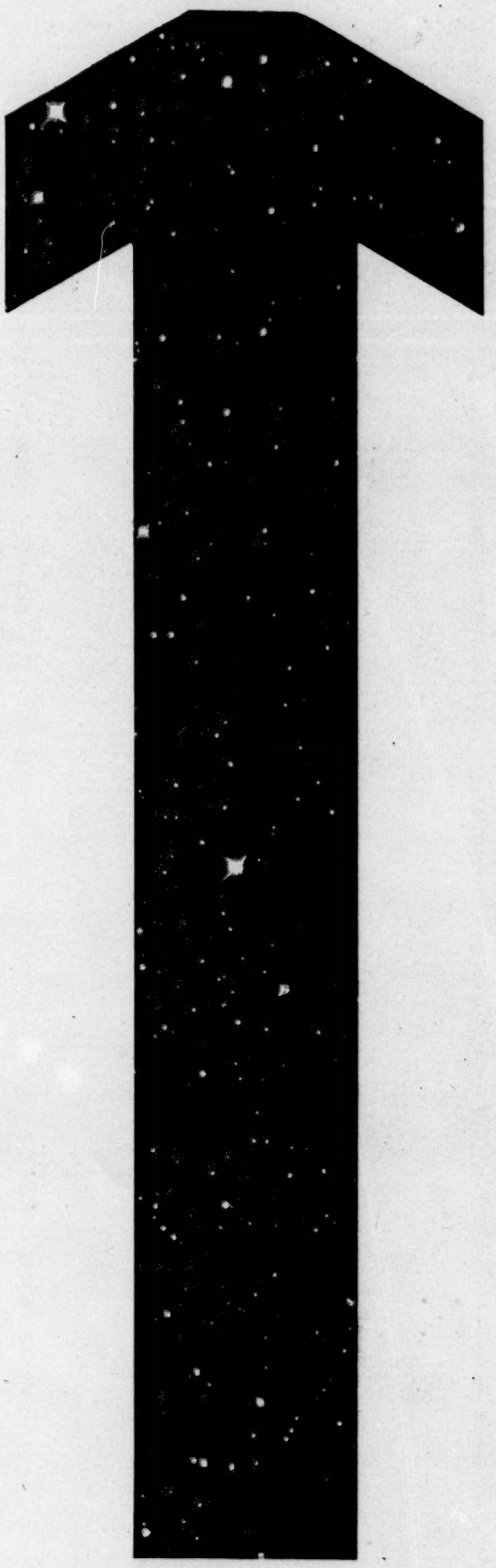
Goodyear Aircraft Corp. has received a $5-million supplemental contract from Navy's Bureau of Weapons to conduct further developmental research on the SUBROC anti-submarine missile.

Rucker Co., of Oakland, Calif., will provide engineering services and hydraulic systems and components for Minuteman ICBM underground launch silos and control centers in South Dakota under U. S. Steel Corp. contract.

Airtek Dynamics, Inc., Compton, Calif., has received an $800,000 contract from Boeing Co. to provide structural fittings for B-52 jet bombers.

B. F. Goodrich Aerospace and Defense Products, Rialto, Calif., will manufacture solid fuel motors for the Sidewinder air-to-air missile under a $780,000 Navy contract.

Lockheed Missiles & Space Co. scientists have proposed that methods be developed for biological decontamination of interplanetary vehicles and components to prevent transfer of possible harmful bacteria from other planets to earth and vice versa.



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A New Achievement in Precision Controls for Space Application

Marquardt Documents 1,000,000th Pulse of Radiation Cooled Bipropellant Rockets

A three year research and development program directed at advanced space propulsion and control systems reached a significant milepost on September 8 when The Marquardt Corporation documented the 1,000,000th re-start of radiation cooled bipropellant pulse rockets. These rockets, operating at pulse frequencies up to 100 cycles per second, demonstrated that combined response and delay times of .006 second and effective pulse widths of .003 second are now attainable. Development to reduce these times is currently in progress.

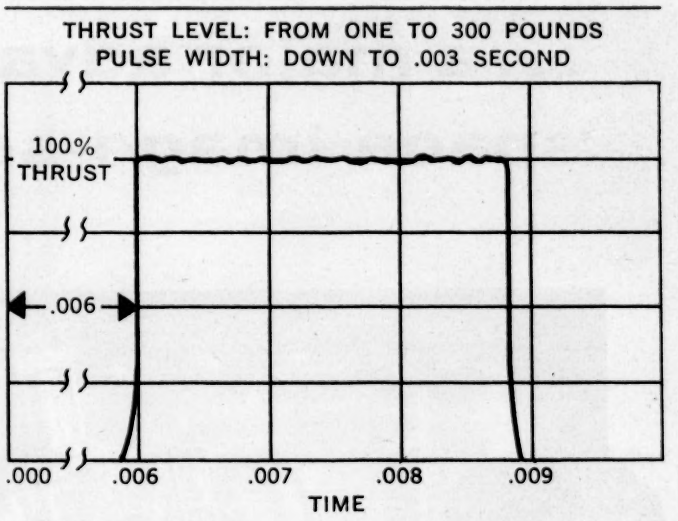
Typical of Marquardt's pulse rocket development in the range of 0.2 to 100 lbs. thrust is a 25 lb. thrust rocket for a current satellite propulsion requirement. *This engine demonstrated an intermittent operational life of over 50 minutes at rated thrust, and has achieved a remarkable 46 minute continuous run.* At the end of the test, there was no evidence of system deterioration. This type of rocket engine has repeatedly demonstrated a space Isp of 310 seconds using hydrazine and nitrogen tetroxide as propellants.

Coupled with Marquardt's secondary injection, gimballing techniques, and throttleable rockets, these pulse rockets make possible a range of control systems that can meet the most advanced space control requirements. In a complex lunar landing-return mission, a Marquardt system can provide main course velocity control, orbital ejection-injection, descent-ascent control, and lunar circumnavigation.

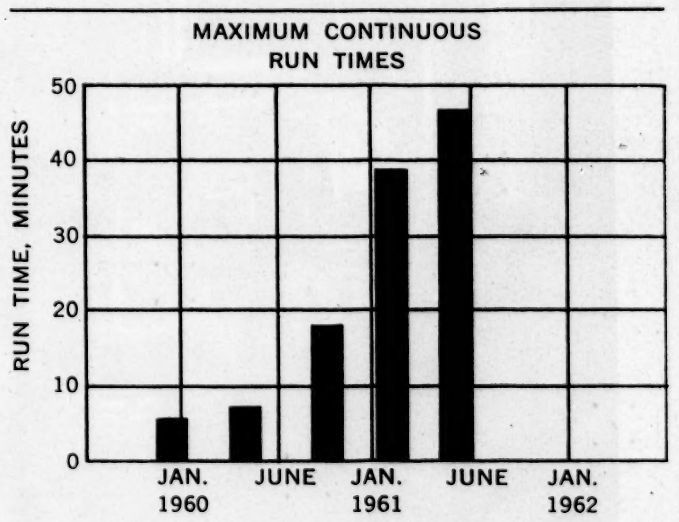
Marquardt's sixteen years of research and development in controls have led the company into many pioneering areas in the aerospace field. In variable thrust engines, Marquardt rockets, using storable liquid propellants, proved an average C* efficiency of 95% over a wide throttling range. Successful investigations and developments have been achieved in injectants for thrust vector control, including tap-off of hot gases from the primary combustion chamber, cold gases such as nitrogen or air, non-reacting liquids such as freon and reacting liquids such as hydrazine.

The Marquardt Corporation today provides the aerospace industry with one of the most extensively documented records in the area of space propulsion controls systems and components. Be it part or package, Marquardt can prove a record of performance which insures reliable products delivered on time and at minimum cost. For additional information contact R. L. Oblinger, Chief Application Engineer, Power Systems Division.

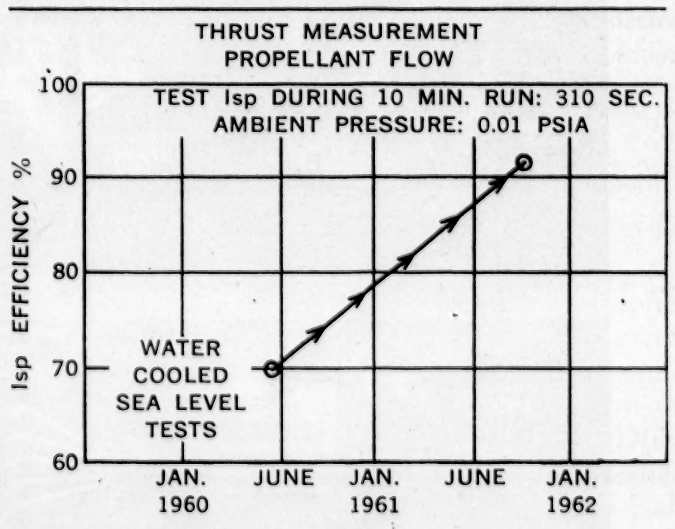
Engineers experienced in these or related fields will find it rewarding to discuss career futures with Marquardt — an equal opportunity employer.



DOCUMENTED IMPULSE CAPABILITY
The above trace represents one impulse bit — demonstrating controllability of pulse width down to .003 second.



RADIATION COOLED THRUST CHAMBER RUN
Continuous 46 minute run duration of radiation cooled thrust chamber with N_2H_4 and N_2O_4 demonstrated a 90% efficiency with no degradation in performance during run and showed no adverse effects on the system.



DEMONSTRATED Isp EFFICIENCY
This chart shows thrust efficiency increase over slightly more than two years. Latest tests prove an Isp of 310 seconds, during a ten minute run at 0.01 PSIA.

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◆ POMONA DIVISION
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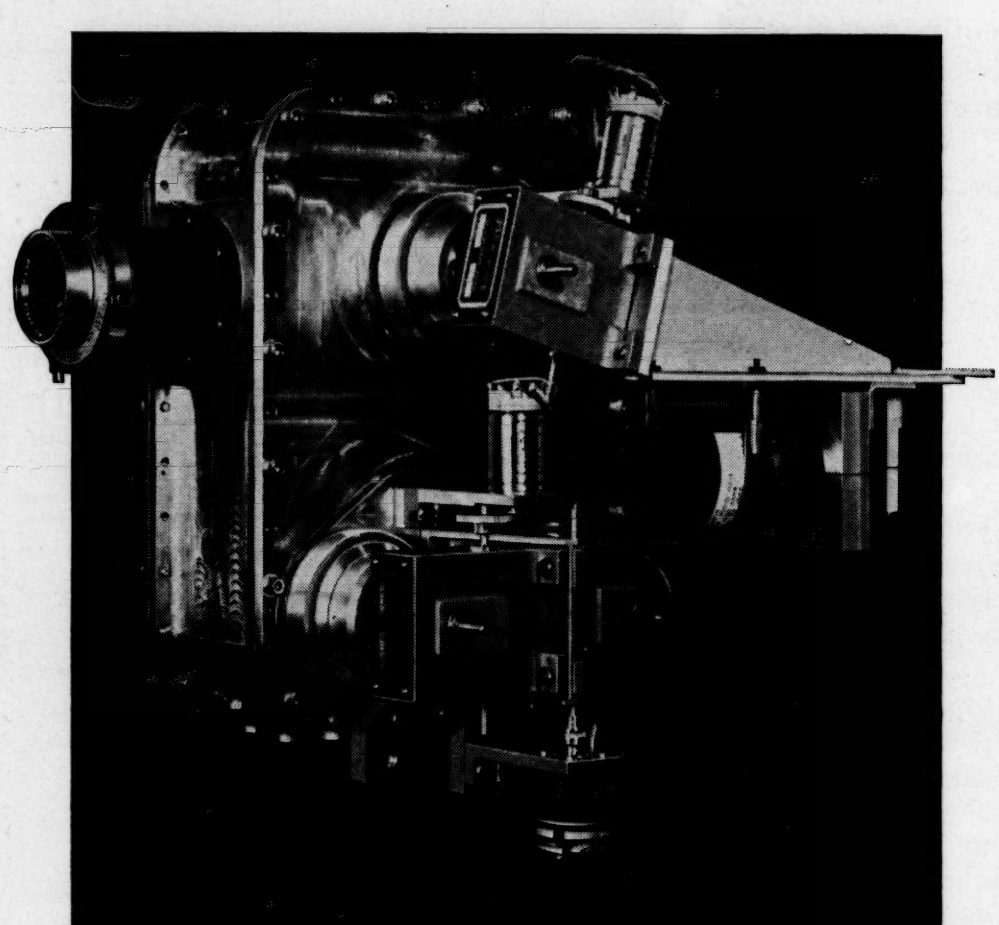
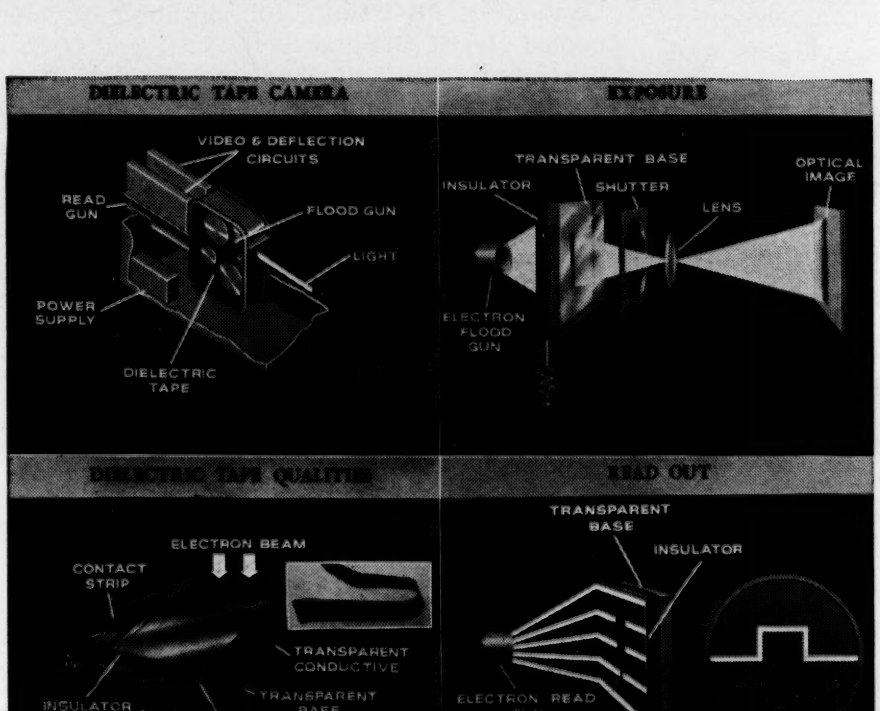
PHOTO-DIELECTRIC TAPE CAMERA SYSTEM

. . . a major advance in space image-sensing





The development of photo-dielectric tape permits the design of a totally new image-sensing system for utilization in satellites and space vehicles. A prototype camera for use with this tape has already been operated and tested. This system, one of the first developed primarily for use in space, offers a number of advantages over existing photographic and television techniques.

Operating on the principle of storing an optical image by converting it to an electronic charge pattern, the photo-dielectric system has inherently high resolution since the picture charge pattern is read out directly as a video signal by an electron beam. Moreover, it offers real promise of providing response in various parts of the radiation spectrum in addition to the visible including infrared and ultraviolet with sensitivity better than standard photographic techniques.

Readout is accomplished by use of a finely focused electron beam which scans the charge pattern. It is then converted directly to a video signal for transmission to the ground. Readout can be accomplished at different speeds to compensate for various power and band-width requirements dictated by the nature of the space mission.

The flexibility of the system permits readout of the same image numerous times, if desired, by ground control. In the laboratory, the same image has been read out up to 100 times without serious degradation of quality. Yet, the image is erased completely, with no trace of "sticking," as the tape is flooded with electrons prior to exposure. Transistorization of the package results in minimum weight and low power requirements.

Since a high vacuum is essential to the operation of a photo-dielectric tape camera system, it is "at home" in the harsh environment of space. Also, dielectric tape is virtually unaffected by radiation thereby eliminating this hazard to ordinary photographic film. It is also reusable and serves as its own storage medium for remote picture-taking sequences.

To find out how RCA's new photo-dielectric tape camera developments can fill your requirements for space image-sensing systems, write to the Manager, Marketing, Astro-Electronics Division, Defense Electronic Products, Radio Corporation of America, Princeton, New Jersey.

And for a challenging, rewarding career in electro-optical systems development, apply to the Employment Manager, RCA Space Center, Princeton, New Jersey. All qualified candidates are considered regardless of race, creed, color or national origin.

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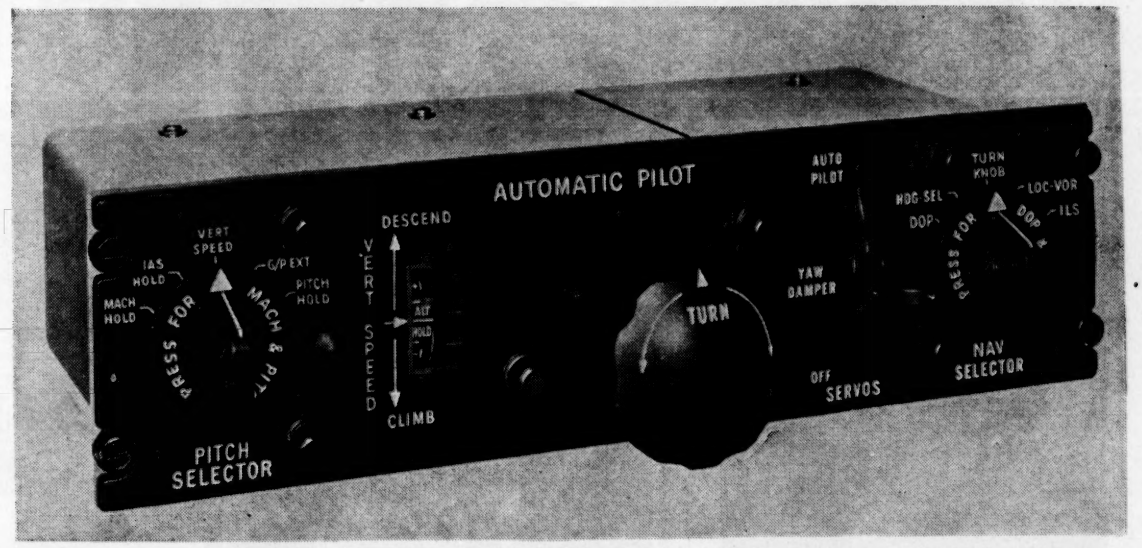
SP-30 to Allow Lower DC-8 Minimums

By Barry Miller

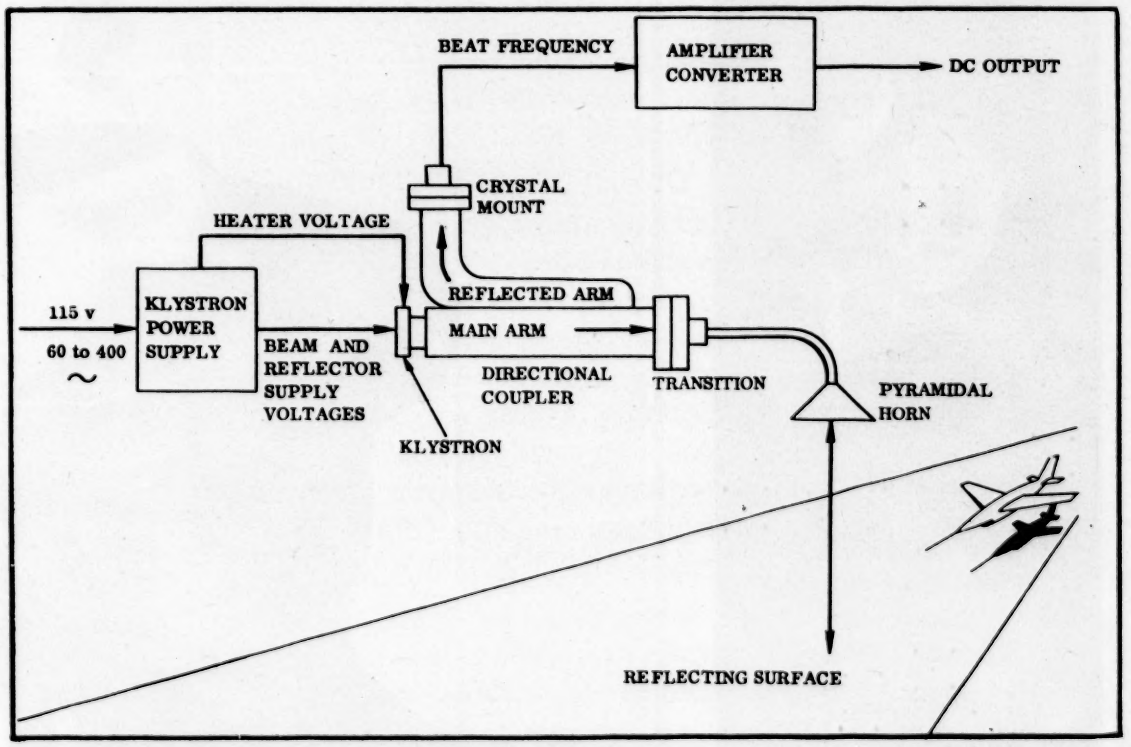
Initial results of a joint Douglas Aircraft/Sperry Phoenix program which will improve the all-weather, low-approach capability of the Douglas DC-8 jet transport will be demonstrated to the aircraft's operators late next month in flight tests at Long Beach, Calif.

The three-phase program is expected to yield a series of progressively lower minimum approach altitudes for the Douglas DC-8. As first evidence of progress with the program, the two companies will flight test on Jan. 25 and 26 a second-generation automatic flight control system which they believe will satisfy the goals of the program's first phase—lowering the present minimum jet ceiling of 300 ft. to 200 ft. At present, however, there is no definite timetable for an effort to secure FAA certification of the aircraft down to the lower minimum.

Like the present SP-30 autopilots (AW Nov. 26, 1956, p. 76) used in the Douglas DC-8, the new SP-30 system will be made by the Sperry Phoenix Co., a division of Sperry Rand Corp.



AUTOMATIC PILOT CONTROLLER, above, for Douglas DC-8 turbojet transport will have settings on pitch selector for constant indicated airspeed, constant Mach and glide slope extension and contain provision for constant vertical speed mode. Sperry Phoenix Co. and Douglas Aircraft are conducting joint autopilot/aircraft improvement program expected to make possible lower jet minimums through extended glide slope.



ALTITUDE RATE MEASURING SYSTEM, made by Spasors, Inc., San Diego, Calif., is being evaluated by Douglas as a part of its DC-8 improvement program. Device mixes reflected signal with generated continuous wave X-band signal to obtain a beat frequency proportional to the rate of descent.

Autopilot Extensions

The new autopilot incorporates a number of extensions such as vertical speed control and glide path extension modes which may make possible the lowering of the adverse weather minimums of the aircraft.

During an approach, the autopilot will memorize the aircraft's rate of descent along the ILS glide slope beam and set it into the autopilot controller. In effect, the glide slope calibrates the rate of descent.

When the aircraft intercepts the middle marker beacon (at about 200-ft. altitude), the glide path ratio signal will be removed and the flight control system will hold to the average speed memorized before the radio control was dropped out. This technique provides an extended glide slope over the more unreliable portions of an ILS glide slope beam.

Pitch Selector

If an airport is not equipped with a middle marker beacon or if the pilot wishes to initiate the glide path extension mode before reaching the middle marker along the glide slope he can do so by setting a pitch selector on the autopilot controller to glide path extension.

Similarly, if he wants to raise or lower the rate of descent during glide path extension he can adjust a thumb dial on the controller.

The autopilot to be demonstrated next month is a somewhat simplified and further developed version of the equipment flight tested by Douglas at Long Beach late last summer. That equipment included provision for constant indicated airspeed and Mach control.

Results of these earlier tests indicated better aircraft stability to 50-ft. altitude. The pilot was able to land the plane with the autopilot on by overriding it in pitch. Takeoff and climb with constant indicated airspeed was found to be satisfactory.

Indicated airspeed was held to ±5 kt. IAS and Mach to ±0.01.

The joint Douglas-Sperry autopilot and DC-8 improvement program, broader than just lower aircraft minimums, was undertaken by the two on the basis of a survey of SP-30/DC-8 operational experience and is designed to cut operating costs and boost aircraft use.

The advanced autopilot, Douglas says, is expected to result in:

• **Fewer aircraft diversions** during ad-

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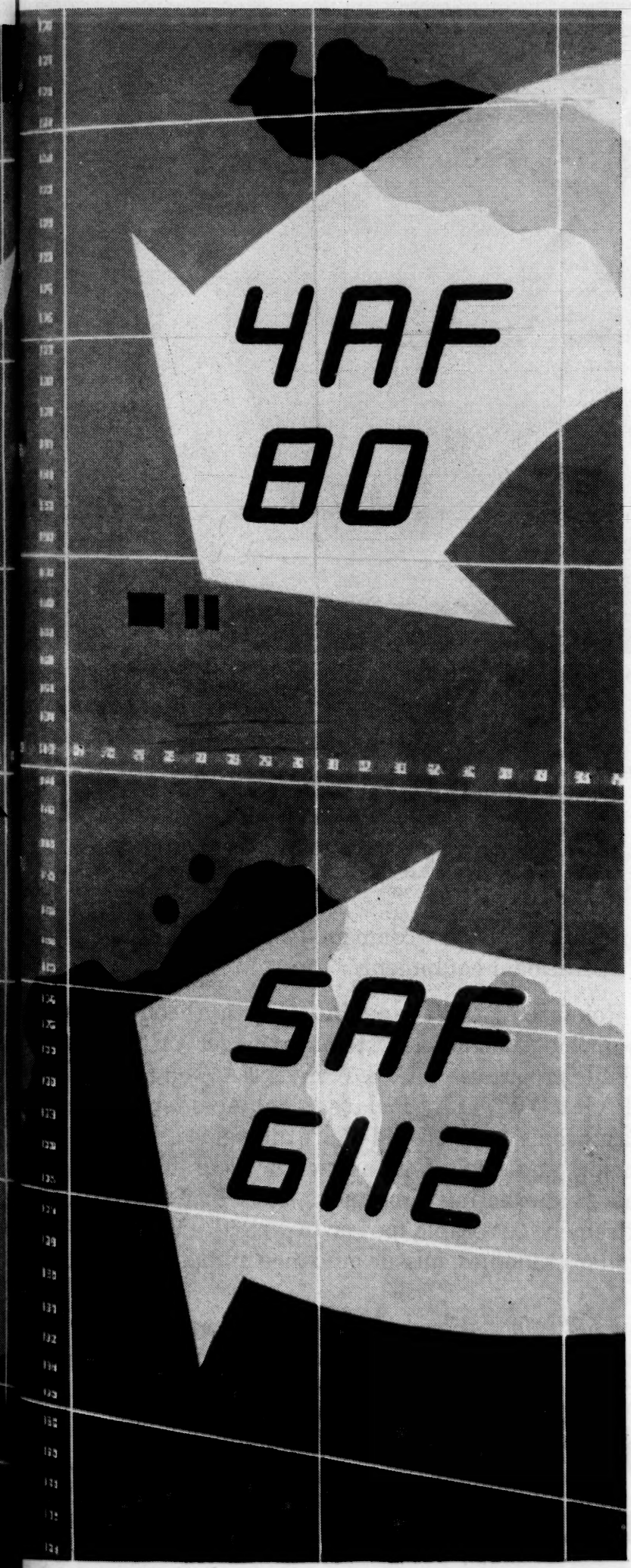

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Progress in electroluminescent display typifies the work being done by the scientists and engineers of the General Telephone & Electronics corporate family. The vast communications and electronic capabilities of GT&E, directed through Sylvania Electronic Systems, can research, design, produce, install, and service complete electronic systems. These systems cover the entire range from detection and tracking, electronic warfare, air traffic control, intelligence and reconnaissance through communications, data processing and display.

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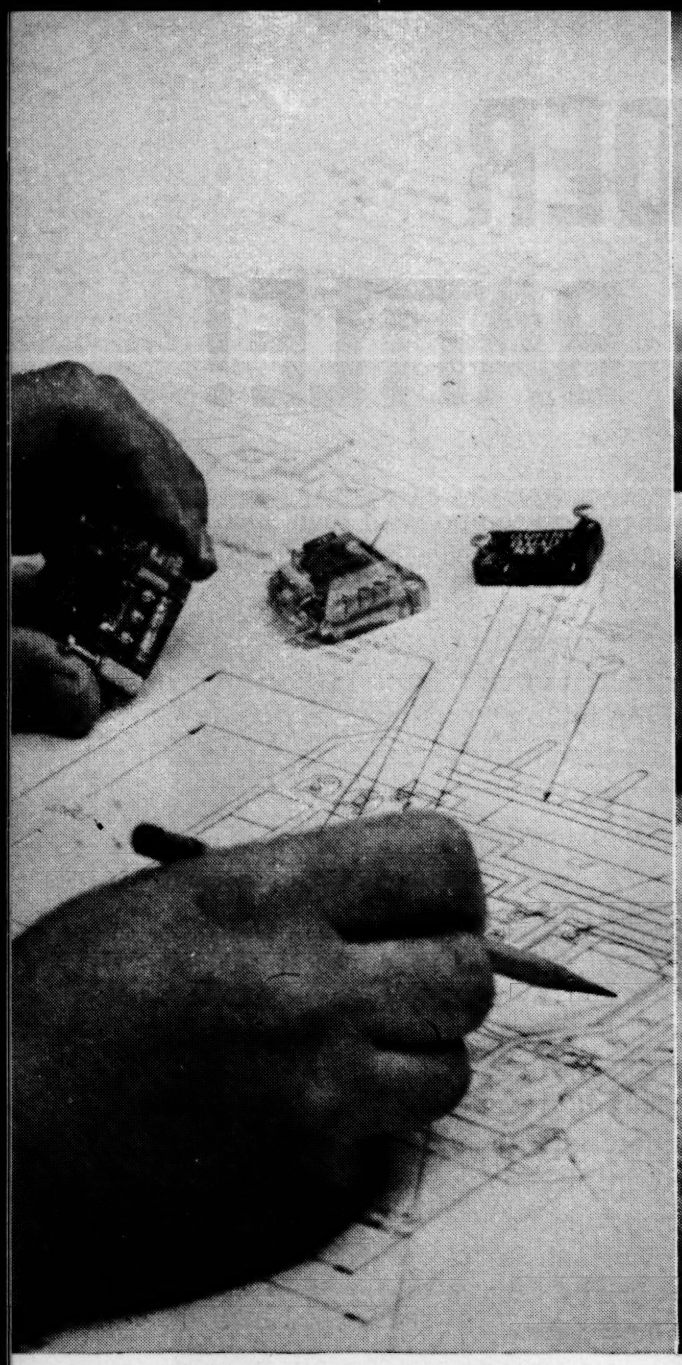
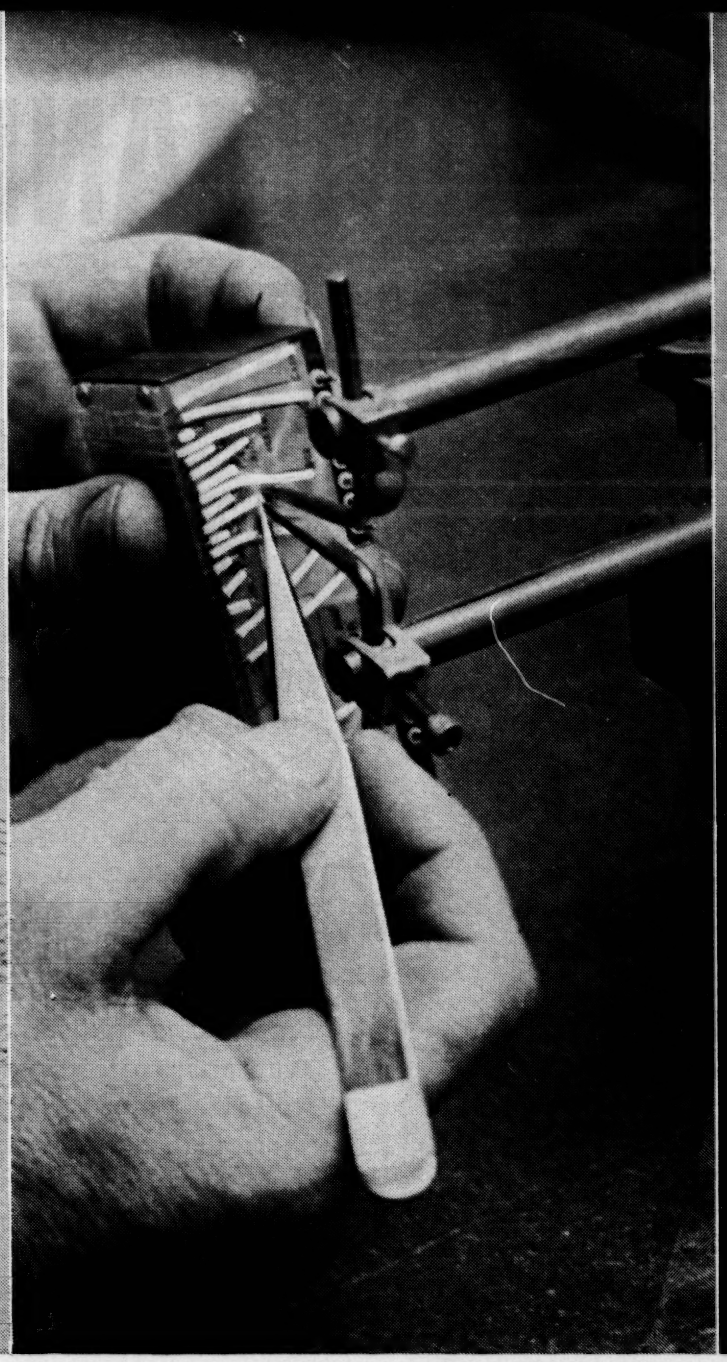


Package design of Weld-Pak® module



Welding interconnections on Weld-Pak® module

Raytheon Weld-Pak® logic stick

Raytheon "Know-How" Supports M.I.T.'s Advanced Polaris Development

Raytheon is presently devoting part of its unique industrial support talents and facilities to system design engineering and manufacture of electronics for the Advanced Polaris Guidance System. For this program Raytheon is under technical direction of Massachusetts Institute of Technology's Instrumentation Laboratory.

For other university or government laboratories, major missile, space and weapons systems contractors, Raytheon capabilities are ideally suited to basic production design, prototype and production manufacture, flight and environment testing, and field support of operational equipment.

Reinforcing these capabilities is Raytheon experience as prime contractor-systems manager on two major missile programs — U. S. Army's HAWK, U. S. Navy's SPARROW III. Related achievements include Raytheon's famed Weld-Pak® all welded, high density analog and digital components, hydraulic actuating valves of exacting dimensions, electrical power units of extremely favorable power-to-weight ratios, weapons systems radomes, missile guidance miniature rate gyros.

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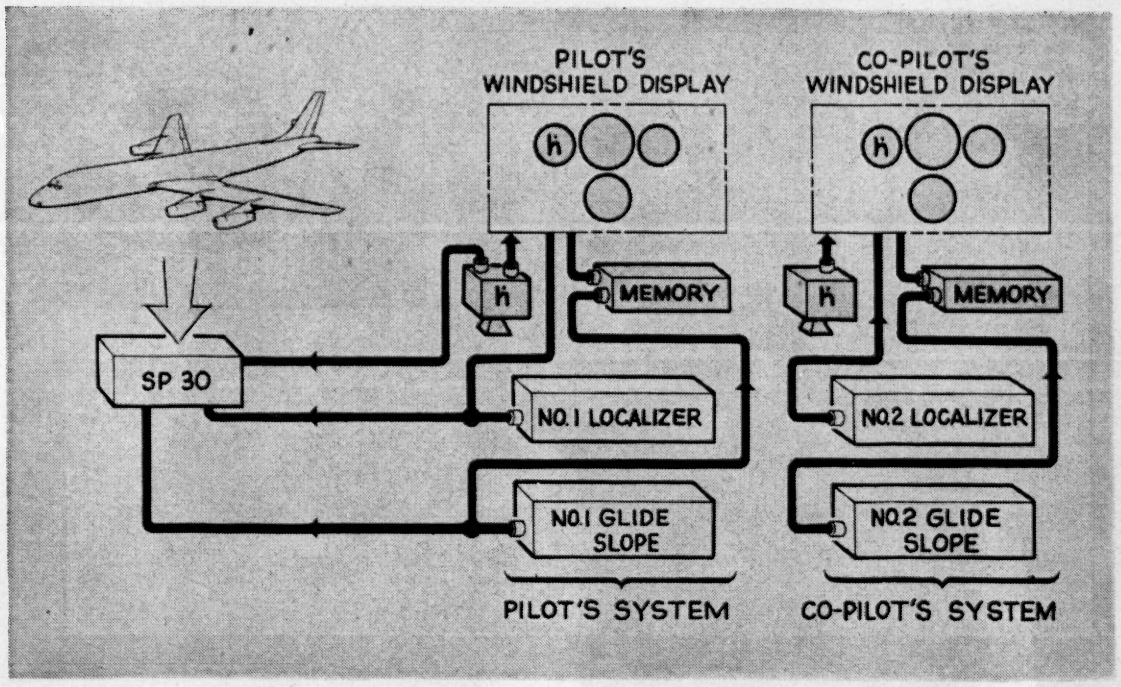
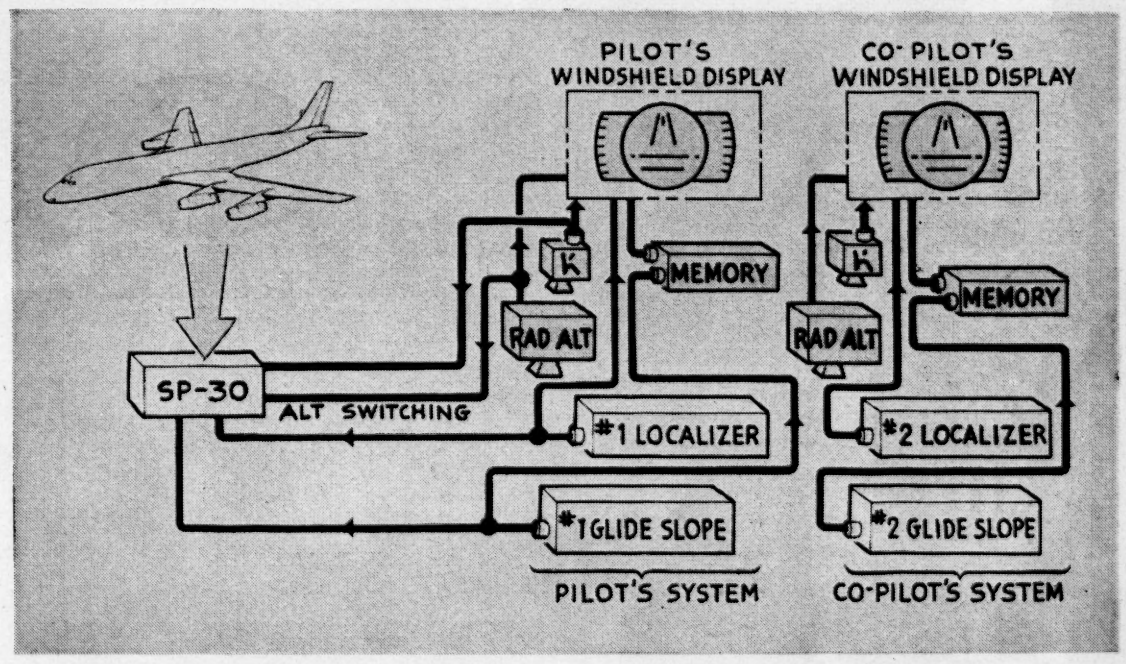


ACHIEVING CERTIFICATION of minimum of 100 ft. for DC-8 probably will involve use of dual vertical rate measuring systems, one of which will drive the autopilot, as well as dual capability for memorizing rate of descent along the glide slope (above). Capability of reaching a minimum of 50 ft. is expected to require windshield displays and absolute height measuring devices (below). No time requirement has been set for achieving either goal, but both are objectives of the current three-phase program being carried out by Douglas Aircraft and Sperry Phoenix Co.



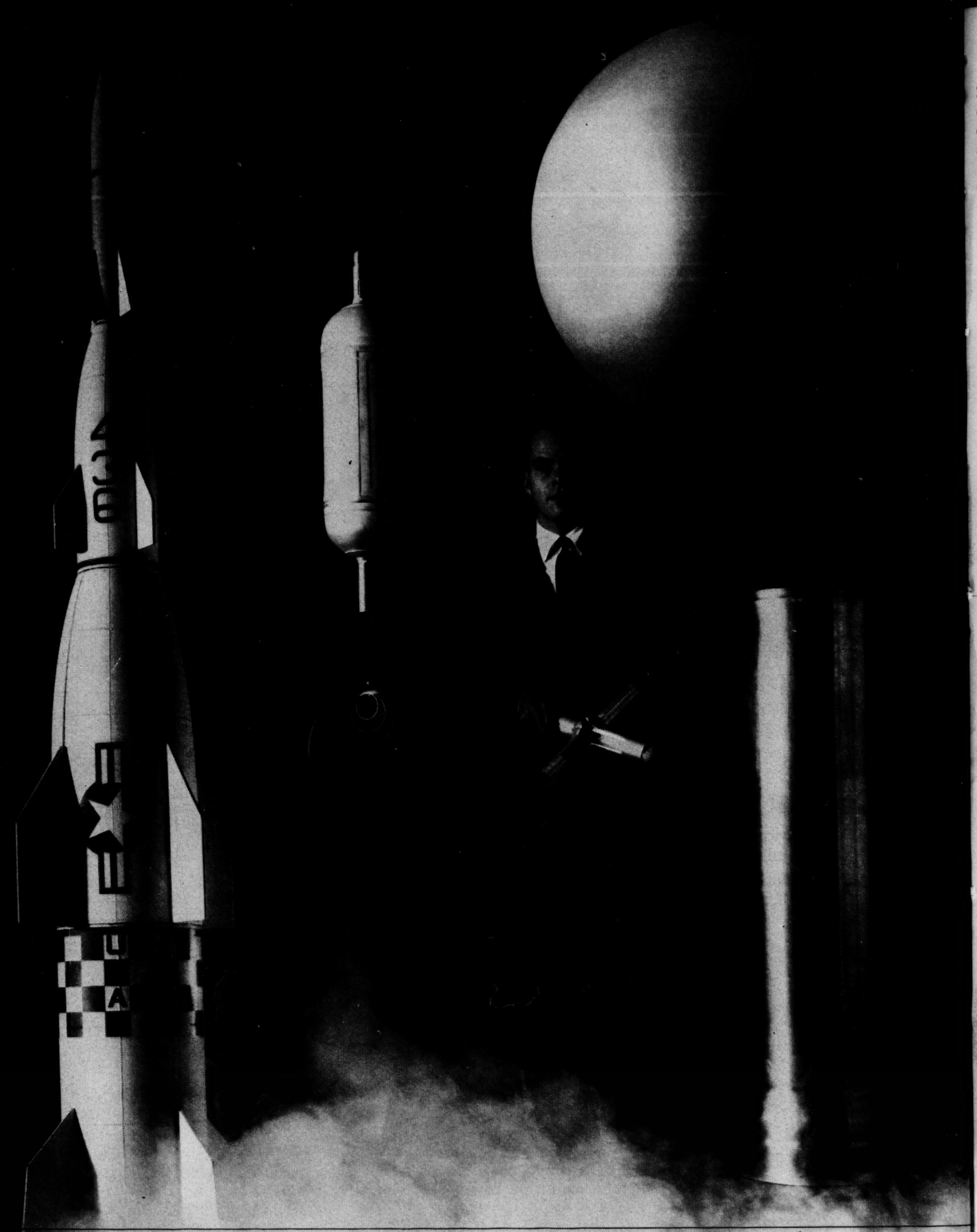
verse weather as a result of the lower minimums.

- **Less fuel consumption** and en route flight time with a more precise steering control.
- **Greater airplane stability** at maximum ratios of aircraft weight to pressure ratios.
- **System which pilot** can monitor from takeoff to landing thereby giving him sufficient confidence which will enable him to commit the equipment to touchdown.

The three phases of the joint program are:

- **Phase A**—Reduce the certified jet minimum from 300 to 200 ft. This goal is in sight with the second generation autopilot to be flight tested sometime next month.
- **Phase B**—Lower the certified adverse weather minimum to 100 ft. While there is no time schedule for implementing this phase of the work, the equipment and techniques needed are under study. Accomplishing this goal may require a barometric-inertial sensor, duplicate of the one used for obtaining rate of change of altitude in Phase A. One of these will drive the autopilot, the other will monitor the first in an effort to increase pilot confidence in the system. A difference between the two could be detected by comparator circuits as well as noted visually. A heads-up windshield display with standard instrument readings projected on the windshield is under study for possible use in attaining the 100-ft. minimum.
- **Phase C**—Certification to 50 ft. This goal is regarded as more remote today. It would require a heads-up display and a direct ground reference through a radio altimeter or its equivalent.

To implement extensions in existing



ALCOA CAPABILITY AT WORK..

weldable cryogenic aluminum allo

that's stronger, thriftier than ste

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

SP-30 autopilots, a kit probably will be offered to the airlines. This would include a new controller plate and parts, a number of other parts, and would require a change in gear ratios, wiring changes in the pressure computer and a few aircraft wiring changes. The changes largely involve extensions or growth from the existing SP-30 autopilots.

The addition of constant indicated airspeed, Mach hold and a capability for instrument monitoring of the glide path extension mode require another pressure computer which will be in the prototype stage at the time of the forthcoming test flights.

Douglas is evaluating a number of methods for sensing vertical speed for use in attaining the goals of Phases A and B. Barometric rate of change of altitude techniques introduce errors due to air mass characteristics, sensing port characteristics, etc., which may be excessive for very low approaches. Deriving this information by differentiating the outputs of radio altimeters may prove unsatisfactory over portions of the approach path because of excessive noise at those approach altitudes where the aircraft is not directly over the runway.

One rather promising approach to obtaining vertical speed signals directly by electromagnetic means was recently flight tested and the results are now being evaluated by Douglas. Essentially a Doppler technique, the method as used in a device developed by Spasors, Inc., San Diego, may provide high resolution readings over a large portion of the approach path, particularly from the middle marker to touchdown. The device is expected to supply altitude descent rate readings to a resolution of 0.1 fps. up to altitudes of 1,500 ft. and handle sink rates from ½ fps. to 25 fps.

The device radiates cw X-band energy from a horn to the ground. A portion of the energy reflected from the ground is mixed with some of the transmitted signal resulting in a beat audio signal. The periodic peaks and valleys of this signal are a direct function of the distance (corresponding to the wavelength of the radiated X-band signal) the aircraft descends. The rate of descent is then a direct function of the frequency of the beat signal. The latter is passed through a feedback signal-conditioning amplifier and converted into a d.c. output which provides a measure of the altitude rate of descent.

Douglas has been discussing radio altimeters for the DC-8 improvement program with a number of companies including Collins, Bendix, Emertron, Sperry and Spasors.

The Douglas DC-8 improvement program constitutes only a part of Sperry's activities associated with all-weather approach and landing of transport aircraft. Other Sperry activities in these areas include:

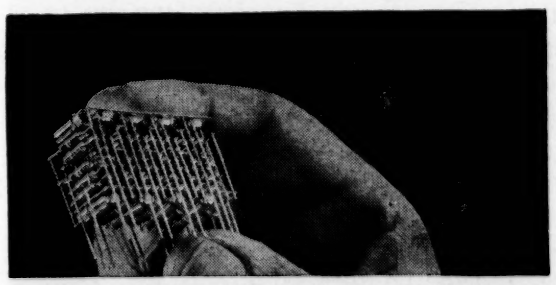
• **Windshield display of flight data**—A windshield display designed to satisfy jet transport requirements is in development at Sperry Gyroscope Co. and has been tested at MacArthur Field, N. Y. The company regards this heads-up display as a means of achieving easy transition from IFR to VFR operation at low altitudes, as a monitor of automatic approach performance and an aid in making all-weather landings manually. Techniques for incorporating approach and runway lights into a display of this type to give the pilot a realistic picture of his situation during IFR approach, landing or go-around are among other Sperry activities.

• **Boeing 727 autopilot**—Building a glide slope extension capability into the SP-50 automatic pilot for Boeing's 727 short-to-medium range jetliner. This includes dual yaw dampers with provisions for making pitch and roll channels dual as well. Conservative packaging and use of derated components and circuit redundancy is expected to provide high reliability.

• **Agency contracts**—Company is under contract to FAA and USAF for coupling Sperry automatic flight control equipment in a C-54 and C-131 to the REGAL system for evaluation at the FAA Center in Atlantic City. It will equip a DC-7 for automatic operation with the British BLEU system for automatic landing tests at Atlantic City.

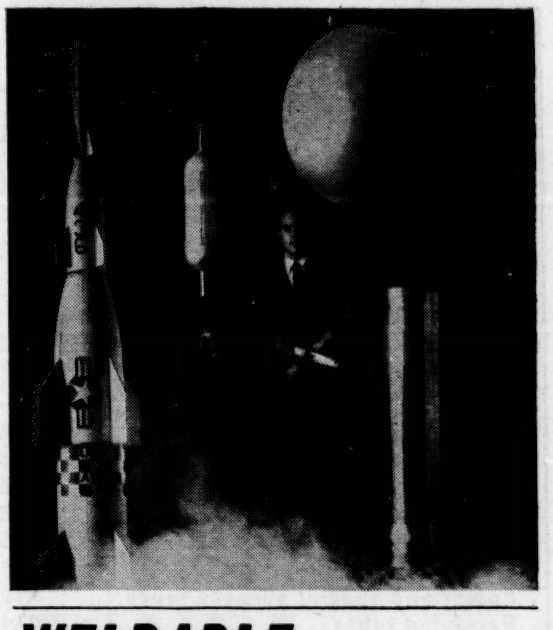
• **Automatic landings**—Several hundred fully automatic landings have been made recently by a company engineering test aircraft at MacArthur Field. System in the aircraft employs conventional ILS facilities, an SP-30 autopilot with radio altimeter and flare computer for hands-off landings.

• **Related projects**—Other activities in these fields at Sperry include electronic monitoring and pilot warning equipment, comparators for continuously evaluating performance of autopilot and instrument sensors, automatic approach projects for helicopters, cockpit displays including vertical-reading instruments and automatic throttle controls of the types used in the company's drone and helicopter programs.



Welded Modules

High-density, welded avionic modules with active components around the periphery to simplify maintenance have been produced for digital computers by Litton Systems, Inc.



WELDABLE CRYOGENIC ALUMINUM ALLOY THAT'S STRONGER, THRIFTIER THAN STEEL

At —423°F (boiling point of liquid hydrogen), Alcoa® Aluminum Alloy 2219 has an ultimate tensile strength of 92,000 psi. Even at elevated temperatures, 2219 alloy's mechanical properties are superior to those of any other commercially available aluminum alloy.

Alloy 2219 has other likable attributes. For one, it costs about one-quarter as much as stainless steels. For another, it's easy to form and is as weldable as aluminum alloy 6061. Also, it is compatible with presently used fuels and oxidizers and has good ballistic characteristics.

ALL ABOUT CRYOGENICS — Alcoa Research and Development Laboratories possess considerable information on the high- and low-temperature properties of aluminum alloys. If alloy selection or the fabrication of cryogenic aluminum presents difficulties, get in touch with Alcoa. Odds are overwhelming that out of the minds of the men who staff these laboratories—or from the volumes of aluminum data at their disposal—there will come the answer.

Write: Aluminum Company of America, 1870-M Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

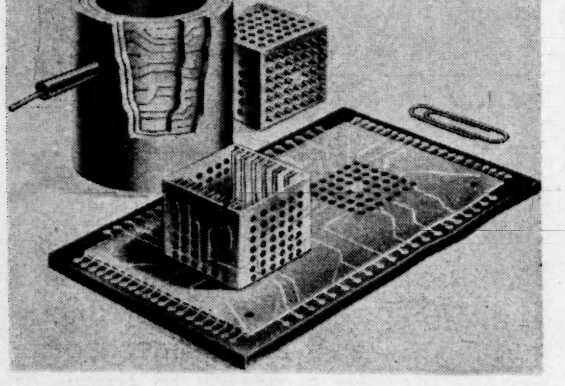
ALUMINUM COMPANY OF AMERICA

Estimated Shipments of Electronic Components Second Quarter, 1961

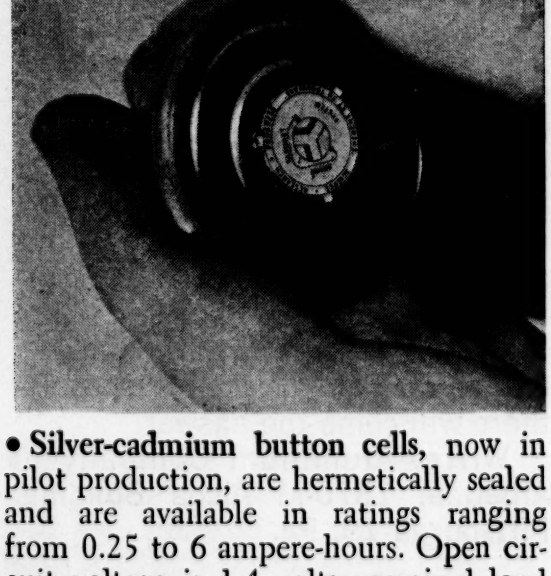
Source: United States Department of Commerce

Category	Quantity (thousands of units)		Value (thousands of dollars)	
	Military	Total (Military + Non-military)	Military	Total (Military + Non-military)
Capacitors	35,324	356,053	23,056	7,328
Connectors	15,425	28,579	29,001	46,312
Quartz crystals	566	1,634	1,570	96,680
Relays (for electronic applications)	2,105	7,570	21,225	46,308
Resistors	57,330	605,729	26,921	67,172
Transformers and reactors	1,639	7,981	19,293	44,645
Power and special purpose tubes	710	1,870	46,605	70,099
Receiving tubes	7,014	98,883	12,682	85,080
Semiconductor devices	32,507	123,240	58,507	146,041
Total	.....	.....	238,860	586,265

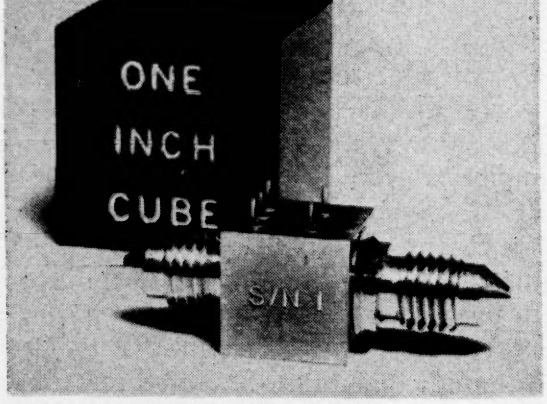
NEW AVIONIC PRODUCTS



• **Multilayer printed circuits,** separated by layers as thin as 2 mils, are available as tubes, spheres, cubes, and other geometric shapes, with copper, nickel, gold, or rhodium conductors. Interconnections can be made to any layer, and conductive paths can be carried over edges and around corners. Manufacturer: J. Frank Motson Co., Flourtown, Pennsylvania.



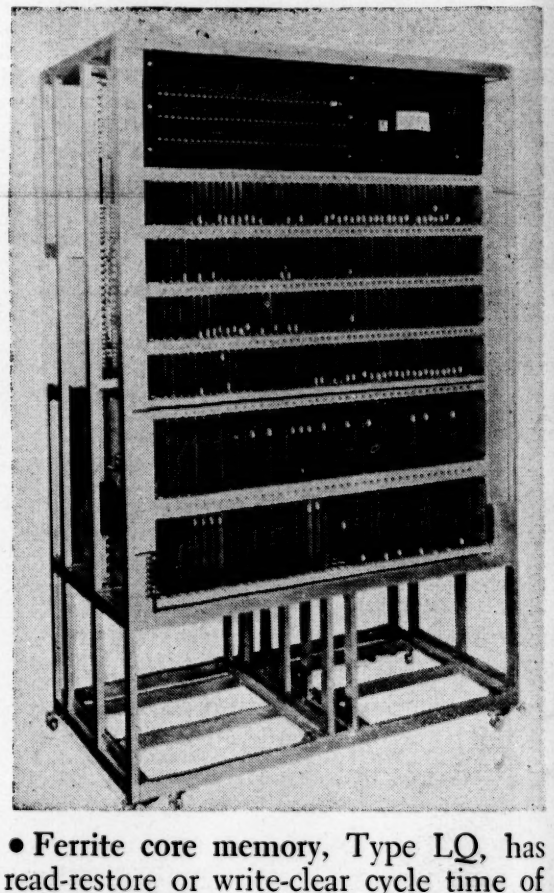
• **Silver-cadmium button cells,** now in pilot production, are hermetically sealed and are available in ratings ranging from 0.25 to 6 ampere-hours. Open circuit voltage is 1.4 volts; nominal load voltage is 1.1 volts. Manufacturer: Yardney Electric Corp., 40-50 Leonard Street, New York, N. Y.



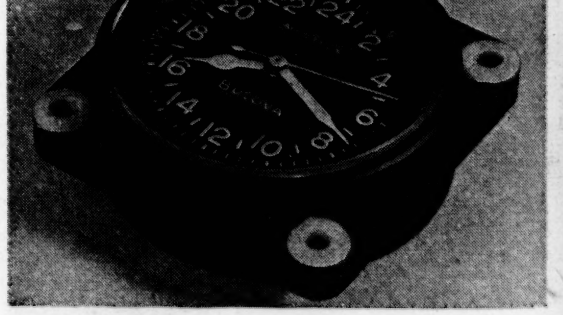
• **Silicon pressure transducer** uses semiconductor as integrated pressure sensor and output device. Prototype models have pressure ranges from 80 to 500 psi. between −65 to +250F. Natural frequency is greater than 25 kc., with dynamic response to 6 kc. Manufacturer: Giannini Controls Corp., 1600 S. Mountain Ave., Duarte, Calif.

• **Versatile UHF antenna** for ground-to-air communications offers both high-gain directional and low-gain omnidirectional characteristics. The antenna, manufactured by General Dynamics Corporation, is designed for long-range communication (up to 300 mi.) as well as for approach or ground control communication. Beam direction can be selected by means of small control box located at operating position. Antenna has overlapping lobes at military distress frequency, so distress signals can be received from any direction without switching. Antenna can be mounted on standard 2 in. diameter mast. Weight is 10 lb. Manufacturer: General Dynamics Corp., Pomona, Calif.

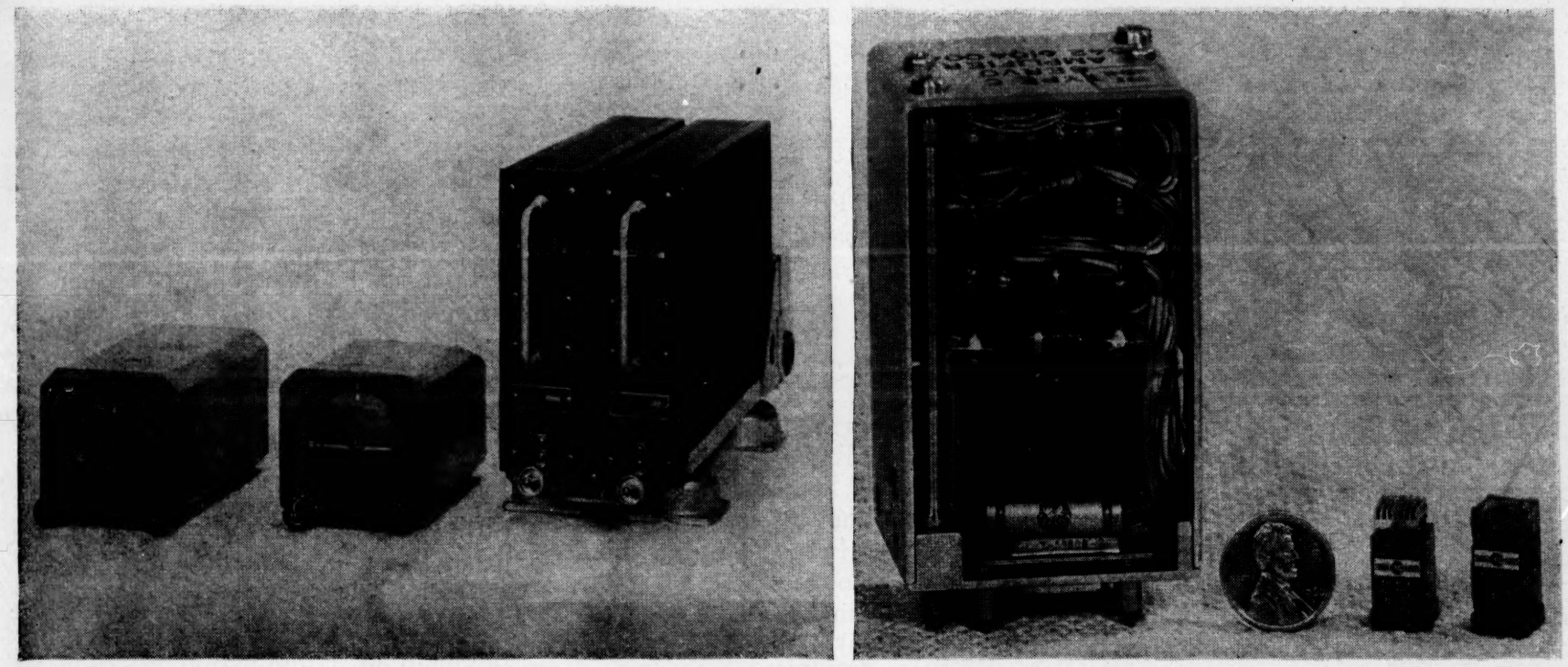
• **Loran-C timing receiver,** Model IF-100A, is broad band, fixed-tuned receiver for 100 kc. Loran-C pulses used in precision frequency synchronization, precise timing, and ionospheric studies. Instrument is transistorized, and is available for relay rack mounting. Manufacturer: Aerospace Research, Inc., 153 California Street, Newton 95, Massachusetts.



• **Ferrite core memory,** Type LQ, has read-restore or write-clear cycle time of 1.5 microseconds. Random access memory is mounted in free-standing frame which contains ferrite core stacks and associated logic circuits and power supplies; dimensions are 72 in. high, 48 in. wide, 28 in. deep. Available in 2048, 4096, and 8192 word capacities (56 bits/word). Manufacturer: Ampex Computer Products Co., P.O. Box 329, Culver City, Calif.



• **Self-powered timing device,** Model TE-10, incorporating mercury cell and germanium or silicon transistor, has maximum error of ±2 sec. per day. Operating temperature range is 0 to 50C with germanium transistor, −40 to +80C with silicon transistor. Size is 1⅛ x 1⅛ x 0.547 in.; weight is 1.2 oz. Instrument is available with 12- or 24-hr. face. Hour and minute hands are set from rear; provision for setting second hand is optional. Manufacturer: Bulova Watch Co., Inc., Flushing 70, N. Y.



APPLICATION OF MICRO-MODULE CIRCUITS to AN/ASN-33 approach horizon and course indicator system has enabled Collins Radio to squeeze computer and amplifiers into indicator cases, right, eliminating two black boxes, left.

Micro-Modules Slash Instrument Weight

By Philip J. Klass

Collins Radio Co. has achieved significant savings in size, weight and power consumption in two flight director instruments through the application of Micro-Modules, developed originally by Radio Corp. of America under Army sponsorship.

To evaluate potential benefits that could be obtained from new microelectronic construction techniques, Collins selected its AN/ASN-33 horizon and course indicators as a guinea pig. Company builds the ASN-33 for the Army, but has sold similar units to airlines for use on jet transports.

The standard ASN-33 requires two separate black boxes, each ½-ATR size, occupying a total of 500 cu. in. and weighing 11.7 lb., not including shock mounts and interconnecting cabling.

Using Micro-Module circuitry, Collins achieved a 100:1 reduction in volume, permitting the resulting 5 cu. in. of circuitry to be built into waste space within the instrument indicators. The Micro-Module circuitry weighs ¼ lb., representing a weight reduction of 50:1, not counting the saving in weight of cabling and shock mounts.

The over-all saving in total system weight amounted to about 50%. The standard ASN-33 weighs about 20½ lb. including two indicators and amplifiers, while the micro-modularized version weighs only 9 lb.

Savings in power consumption were nearly as significant. Where the original ASN-33 computer and servo amplifiers required 37 watts of power, the new version consumes only 6.1 watts, according to E. H. Fritze, director of development of Collins Division "C" in Cedar Rapids, Iowa.

Ability to build all the circuitry into the indicators has important by-product advantages. Improved reliability should result from eliminating interconnecting cables, a potential source of trouble. When a malfunction does occur, it is only necessary to replace the single defective indicator whereas in a standard AN/ASN-33 it would first be necessary to isolate the fault to the indicator, amplifier or cable.

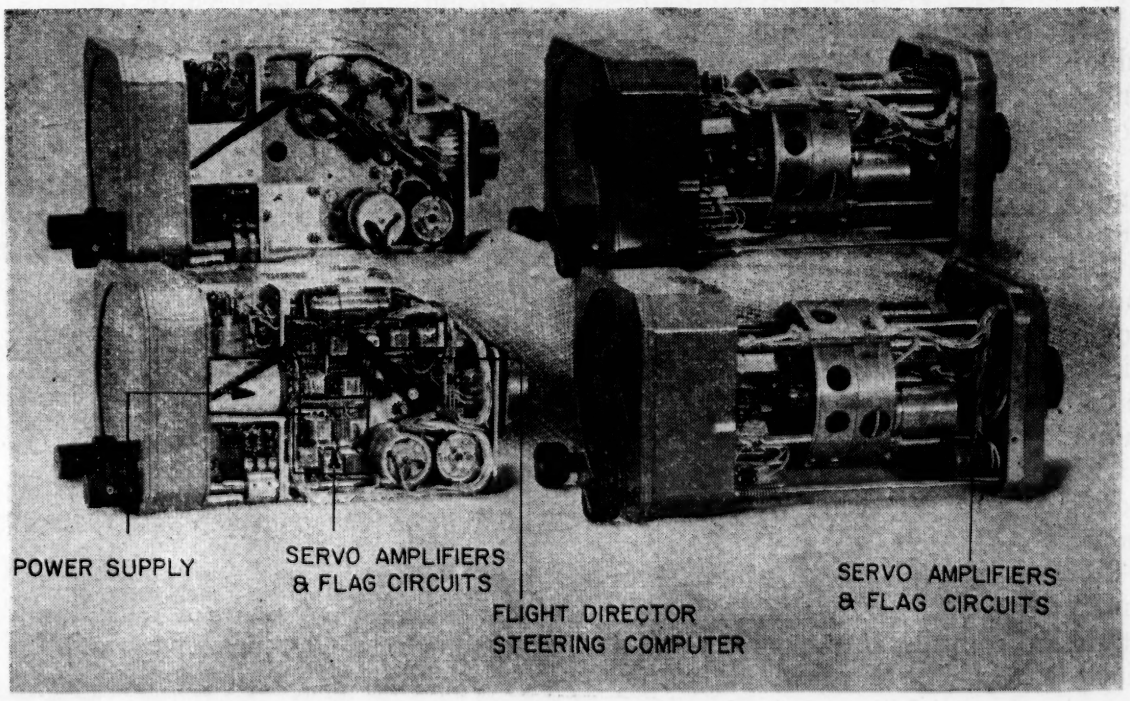
Program was launched as an exercise to determine the suitability of different micro-miniaturization concepts to the type of products Collins produces. Much of the emphasis in industry to date has been on applying micro-circuitry techniques to digital computers and data processing equipment.

After reviewing a number of different techniques, Collins selected the RCA/Army Micro-Modules for its initial effort. One reason behind this choice was the comparatively wide range of commercially available micro-elements from which modules could be constructed. None of the commercially available RCA Micro-Modules was suitable for Collins' needs so its engineers worked from micro-elements to build their own designs.

Circuit design was carried out by company's Instrument Development Division while modules were laid out and fabricated in the company's chemical and materials fabrication laboratory.

First step was to design circuits which could be duplicated with available micro-elements and micro-components. Breadboard models of these circuits first were built with conventional components. Next equivalent Micro-Module circuits were fabricated and tested piecemeal in the breadboard circuit until the final design was frozen.

In the process, Collins found it neces-



MICRO-MODULES are located in former waste space within indicator cases, below. Standard versions of horizon, left, and course indicator, right, are above.

sary to redesign servo amplifier circuits to eliminate output transformers. This was accomplished by using complementary PNP-NPN micro-transistors for phase inversion.

Where required components were not available already mounted on the 0.3 in. square ceramic micro-elements, Collins purchased the components and mounted them on blank wafers. In other cases, additional components were added to existing micro-elements to increase component density.

Collins reports it has achieved average component densities of about 210,000 per cu. ft. in the present instrument designs.

The modules containing the servo amplifier output transistors have miniature heat radiators built on the top of the module, with spare riser wires providing improved heat transfer from transistor cases to the radiator.

Experimental Indicators

Experimental ASN-33 indicators have been given performance tests over the temperature range of −55C to 70C and have met all performance and test standards required of the conventional ASN-33, Fritze reports. In the near future, Collins plans to install the instruments in a company aircraft for flight evaluation.

Company has no present plans for production of the Micro-Module type instruments, but naturally hopes it can interest the Army or other military service.

Asked about the comparative cost of building the ASN-33 with Micro-Module circuitry versus standard construction, Fritze said that it is too early to tell for certain.

However, preliminary estimates indicate the micro-miniature construction may match the cost of conventional construction.

Economical Approach

Certain economies result from the ability to build the circuitry into the indicator itself, instead of having it located remotely.

Relays can be eliminated and the mode selection switch on the approach horizon used instead.

Fritze emphasizes that Collins has not formally adopted the Micro-Module for all future applications, but is continuing its investigations of other promising micro-miniaturization techniques.

This also includes other packaging configurations for using micro-components.

Collins also plans to conduct life and performance tests, using adequate statistical controls, to evaluate quantitatively the effects of micro-miniaturization on the reliability of various equipment.

FILTER CENTER

▶ **Requests For Proposals**—USAF's Aeronautical Systems Division in Dayton is calling for industry proposals for a research-study program to investigate the feasibility of an advanced adaptive flight control system using digital techniques for identification and adjustment of control system parameters and for signal computation. RFP, identified 33-657-62-5347-Q, is available from Code ASKPDC. Other recent research and development RFPs of avionics interest include the following:

• **Long-life communications equipment**, with operational life of 10 to 20 years, for operation in UHF band and higher frequencies, is objective of study and investigation to be sponsored by Aeronautical Systems Division. RFP 33-657-62-5356-Q. Code: ASKPDC.

• **Determination of key parameters** in thin-film deposition of semiconductor and conducting materials is object of basic research program planned by ASD. RFP 33-657-62-5253-Q. Code: ASKPDC.

▶ **Instrument Exports to Japan Increase**—United States manufacturers shipped $18,1 million in scientific and industrial instruments to Japan last year, compared with $15.9 million in 1959, according to study made by Commerce Department Business and Defense Services Administration. The increase reflects growing industrialization in Japan, BDSA says. Japan is second only to Canada as a market for U.S. instruments, according to BDSA. Report on the study can be obtained for 10 cents from Dept. of Commerce, Washington 25, D. C. or any Department field office.

▶ **Airline Air Data Computers**—Central air data (analog) computers capable of providing outputs for true airspeed and Mach number will be obtained by Boeing Co. for installation on 40 of its 727 jetliners scheduled for delivery to United Air Lines. The computers (AW Sept. 19, 1960 p. 95) will be made by Litton Industries under a $410,000 contract. Comparable central data systems, meeting Arinc Airline Electronic Engineering Committee (AEEC) common specs, or characteristics may be purchased for other commercial jet airlines.

▶ **Size Reduction by Cooling**—Significant reduction in size of electronic equipment can be achieved through the use of auxiliary thermoelectric refrigeration units in the package walls, according to recent study by Army's Diamond Ordnance Fuze Laboratories. Copy of the report, "Cooling Large Electronics Packages," identified PB-171540, can be obtained for $1.00 from Office of Technical Services, Commerce Dept., Washington 25, D. C.

▶ **Transistors Tested by Sequential Sampling**—Procedures which establish product reliability by life testing successive small samples and correlating test results over a period of time are now being employed by Philco's Lansdale Division. Because of the small sample sizes, costs are lower than for conventional life testing, which establishes the reliability of a single lot by testing a relatively large sample. The sequential sampling method permits shipment of a production lot prior to completion of the life test period if the sample falls within control limits, with no loss in statistical confidence to the user, Philco reports.

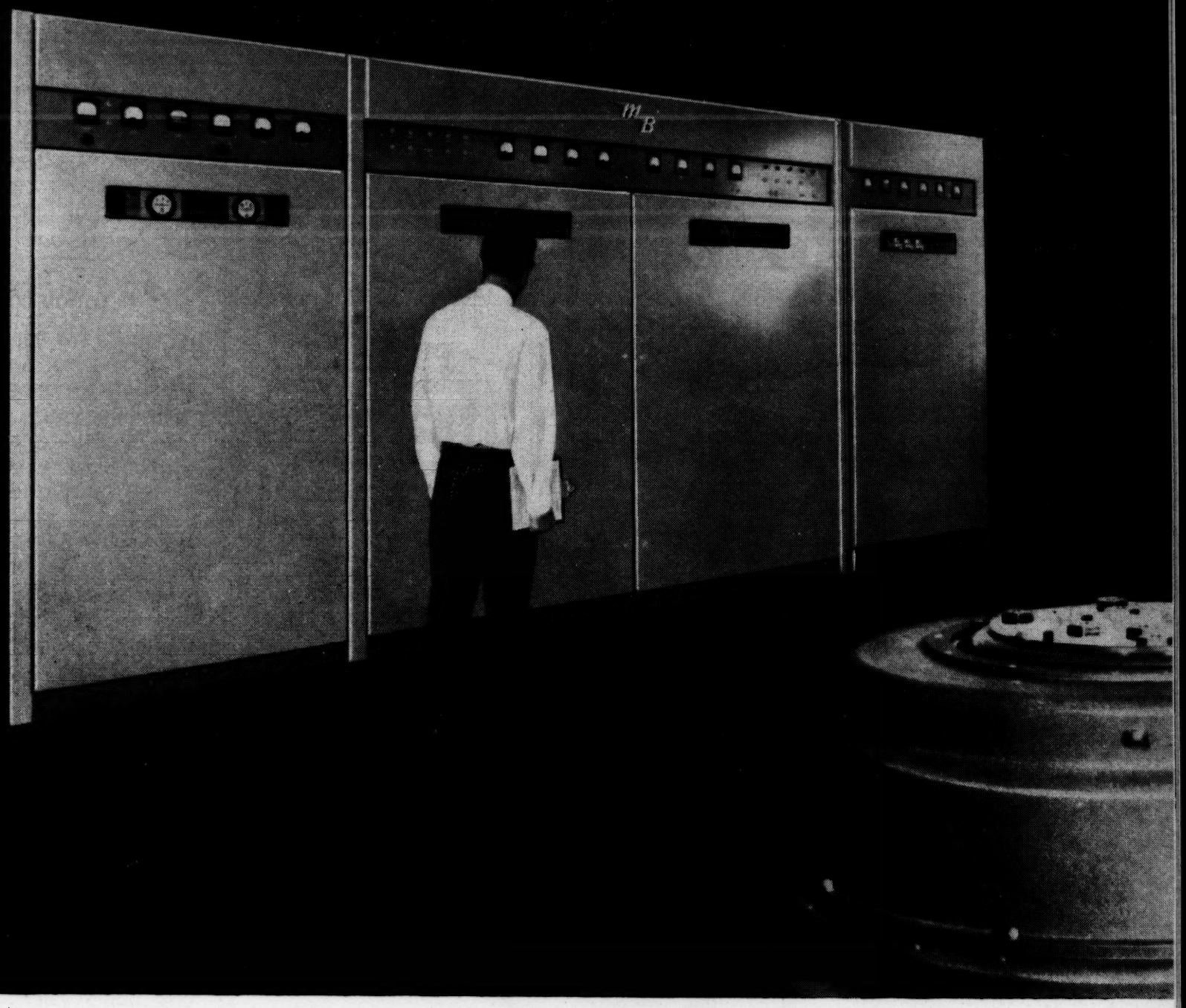
▶ **Russian Claims Radar Discovery**—The Soviet Union is now claiming that a Russian, A. S. Popov, whom they credit with the discovery of radio, also discovered radar in 1897.

▶ **Naecon Calls for Reports**—Prospective authors who wish to deliver reports at the annual National Aerospace Electronics Conference in Dayton, May 14-16, should submit 100-word abstracts and 500-word summaries together with a biographical sketch, all in triplicate, by Dec. 15. Material should be sent to Mr. George A. Langston, 4725 Rean Meadow Drive, Dayton, Ohio. Only original reports which have not been published or delivered prior to the 1962 Naecon will be considered, Langston says.

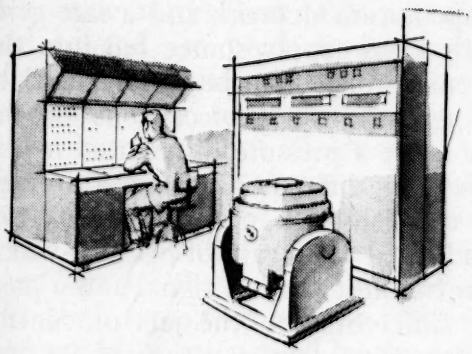
▶ **New Preferred Circuits Supplement**—Supplement No. 4 to Navy Handbook of Preferred Circuits, covering new video amplifiers, emitter followers, video and multi-vibrator circuits, is now available from Government Printing Office, Washington 25, D. C., for 35 cents. Latest addition is identified as NAV WEPS 16-1-519, Supplement No. 4.

▶ **Radio Refractive Index Center Formed**—National Bureau of Standards has established a Radio Refractive Index Data Center at its Boulder, Colo., laboratories which will collect and correlate data on the variable refraction of radio waves at given times, heights and places. Resulting data will be available to interested organizations. Data cataloged to date and referenced is stored on seven million punched cards. New center hopes to collect sufficient data to plot radio refractive index profiles for the atmosphere of the entire earth, NBS says.

The important advances in environmental testing come from MB



New 5140MB power amplifier improves reliability in sine wave and complex motion testing



A pioneer and leader in the field of electrodynamic vibration systems, MB continually strives to improve the performance and reliability of vibration, shock and fatigue testing. The important advances in environmental testing come from MB.

MB Electronics has representatives in principal cities throughout the world.

The Model 5140MB Power Amplifier is designed to drive the Model (C210) 28,000 lb. force and Model (EL 10,000) 40,000 lb. force vibration exciters. Rated at 140,000 volt amperes output with plate dissipation of 240 kw, the amplifier offers the most conservative and reliable operation in the vibration testing field. It will readily handle all the adverse inductive and capacitive loading of the electrodynamic exciter.

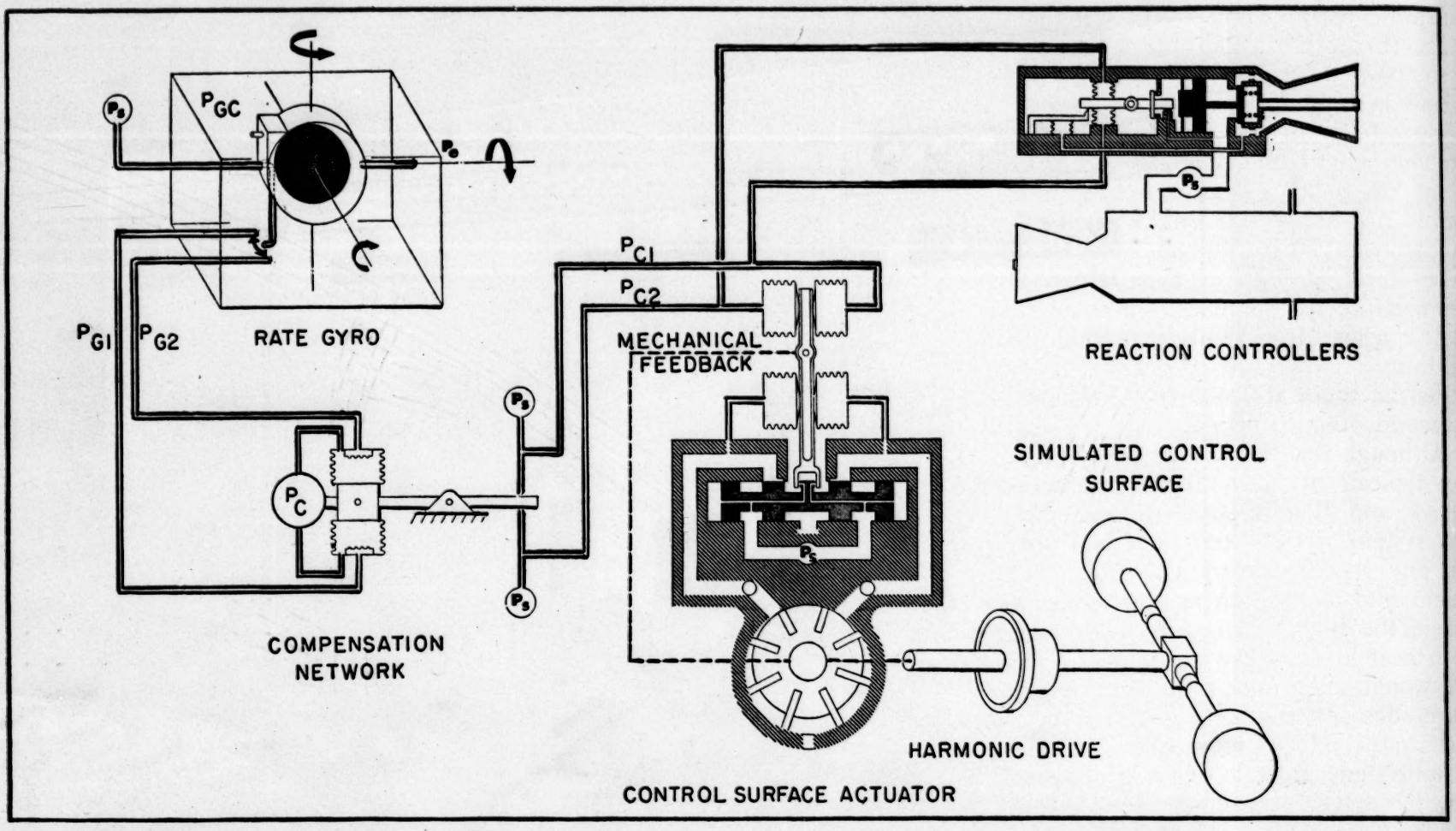
These outstanding features are responsible for the greater reliability of the Model 5140MB amplifier:

1. 15 db negative feedback provides lowest source impedance and lowest distortion into the shaker load.
2. Oversized driver tubes for high random peaks.
3. Oversized amplifier with oversized output tubes.
4. Plate dissipation capabilities exceed vibration exciter requirements by a minimum of 33⅓%.
5. Compact water systems feature "water-miser" regulation of secondary water and a demineralizer insures low conductivity in primary coolant.

For additional information on the new 5140MB Power Amplifier, write for Bulletin 134.

MB ELECTRONICS

A DIVISION OF TEXTRON ELECTRONICS, INC., 1078 State Street, New Haven 11, Conn.



RE-ENTRY STABILITY CONTROL SYSTEM, under study by USAF Aeronautical Systems Division of the Systems Command and the Bendix Corp. for a manned spacecraft, would use hot gas in a completely pneumatic-mechanical system to operate control surfaces or reaction jets. All lines are maintained at a static pressure of about 90 psi., with gas supply reservoirs (P_s) maintained at 180 psi. In the gyro assembly (P_{gc}), gas drives the gyro like a steam turbine and, through a second aperture, is fed into the complete system through a swiveled tube attached to the gyro itself. As the gyro precesses, the L-shaped tube deflects proportionally toward one of two exhausts at the bottom of the assembly, causing an increase in pressure in that line. This pressure differential is transmitted to the compensation network, in which bellows move an arm as a flapper valve. Movement of this arm causes another pressure differential in lines leading to the reaction jets and the control surface actuator. Jets are basically two-stage valves, with a flapper determining input signal strength and a poppet providing the power. Control surface actuator is driven by a flapper input and a spool valve output; output gas drives an expansion vane motor which in turn operates a harmonic drive with a gear reduction of 75:1. Jets would be used during orbit and beginning of re-entry; control surfaces would be used at lower altitudes.

Hot Gas Stabilizing Studied for Spacecraft

By George Alexander

Wright-Patterson AFB, Ohio—Fully pneumatic stabilization system, using hot gas to drive control surfaces and reaction jets on a manned spacecraft, is under study here by the Aeronautical Systems Division of Air Force Systems Command.

Flight Control Laboratory of the division, using a one-fifth scale model powered by nitrogen gas, has demonstrated that individual components—such as the gyros, valves, actuators, control surfaces and jets—can be assembled in an integrated system, capable of transmitting signals and power pneumatically and mechanically.

If component, subsystem and system testing of actual hot gas hardware proves successful, USAF personnel say, the system could be applied to a spacecraft with a flight profile of one orbit and then re-entry—a design objective of the system that also is descriptive of the missions of early Dyna-Soar vehicles.

USAF personnel in the Flight Control Laboratory point out that although much work has been done on pneumatic components, research on integrated hot gas pneumatic systems has been scant. The one-fifth scale engineering model does not prove the feasibility of a hot gas system, they add, but does give an indication of over-all system performance and raises their confidence that a hot gas system can be developed. What makes a hot gas stabilization system attractive, Flight Control Laboratory personnel said, is the predicted requirement of flight control equipment capable of operating in ambient temperatures between 1,000 and 1,500F without excessive cooling support equipment or insulation. A system whose internal temperature is within this range would be unaffected.

Success of this system, which stabilizes the pitch axis only, might lead to an integrated three-axis hot gas system, a USAF officer said.

Basically, the system—as demonstrated by the one-fifth scale model—consists of a series of lines, in which there is a static gas pressure of 90 psi., connecting the control surfaces and the reaction jets to a control actuator, a compensation network and a rate gyro. With a gas supply source fed into the system through a tube rigidly fixed to the gyro housing, precessions of the gyro cause a pressure differential in the lines. This differential is passed through the compensation network, which can be adjusted for a gain of 8:1 and which then transmits both a signal and a pressure differential to the jets or control surfaces through the action of its output arm on two other lines.

Both the contractor—two Bendix Corp. divisions, Pioneer-Eclipse and Research Laboratories—and USAF personnel here at Aeronautical Systems Division believe that the system has great promise because:

• **Completely pneumatic-mechanical,** it has no electrical parts or circuitry. It still would be operable in the event of an electrical power failure in the vehicle. All power and signal transmissions are pneumatic or mechanical.

• **Refrigeration is unnecessary** and insulation requirements are minimal, since the internal temperature of the system—as determined by the 1,300F steam generated by hydrogen-peroxide—is greater than or about equal to the ambient environmental temperature.

System is being designed to operate within this temperature profile:

• **Rise from 70 to 700F** in 10 min.
• **Level off at 700F** and sustain this temperature for 50 min.
• **Rise again, from 700 to 1,400F** in 10 min.
• **Plateau again at 1,400 to 1,500F** for a second 50-min. period.

Although this two-step pattern would be typical of Dyna-Soar's re-entry, USAF and Bendix personnel say that the system is not under development for any specific program and that it might find application in any program where the high speed and consequent high heat loads of the re-entering vehicle would argue against a continuous direct descent and where vehicle control by the pilot is required.

Subsystems include a gas generator, a switch mechanism for selection of the control surface or reaction jet mode of operation, a rate gyro, a compensation network, the control surfaces and the reaction jets. On the one-fifth scale model, the control surfaces were simulated by a dumbbell-shaped weight.

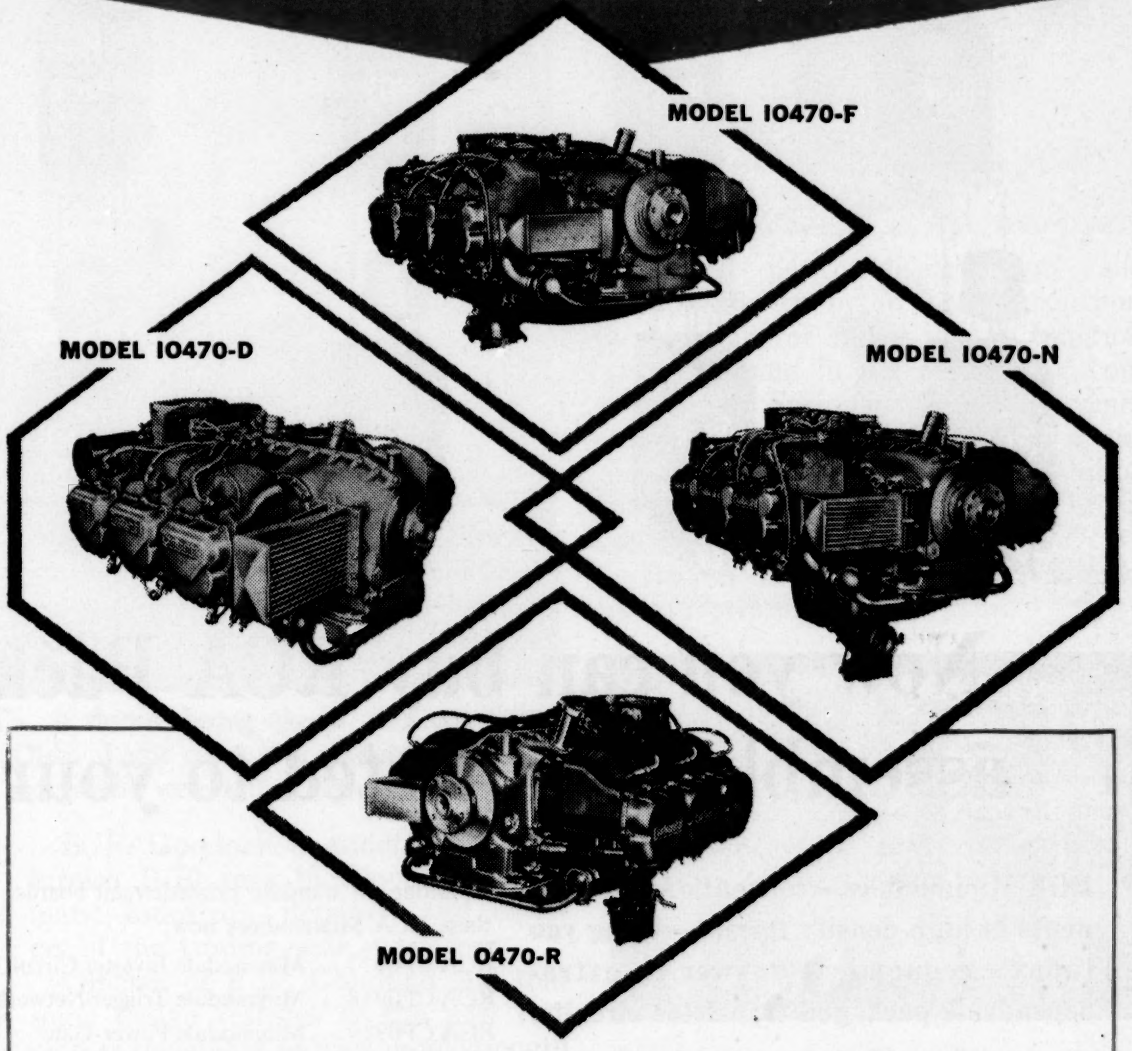
In an operational system, the reaction jets would develop about 100 lb. thrust and would be used to damp out oscillations of the vehicle following orbital injection, during orbital flight and initial re-entry. They could also be used to orient the vehicle on its correct re-entry trajectory. The jets, mounted on the rear of the vehicle near the control surfaces, are linked so that when one is opened, its opposing counterpart is closed.

Control surfaces would be used after aerodynamic forces had built up and would be stiff, to preclude unwanted oscillations. Actuator motor would develop about 8 hp. to drive the surfaces at a maximum speed of 50 deg./sec.

Slight precessions of the gyro, not requiring correction by either the control surfaces or the jets, would be washed out in the compensation network. High signals, above the system's limits, would be attenuated by the pressure lines. If the spacecraft fell into an attitude beyond the system's control, provision could be made for automatic transfer of control to the main propulsion system.

Flight Control Laboratory personnel said that the hot gas system is now being fabricated and that component testing is now in progress. Subsystem testing is expected to begin in January of next year, with complete system tests starting in March and continuing through June, 1962.

3 GOOD REASONS for Choosing a Plane with CONTINENTAL POWER



The preference for airplanes with Continental power rests on a solid three-point base:

1. In few other products for man's use does the quality of dependability count for so much as in aircraft.

2. Advanced engineering, precision manufacture, and rigid quality control have made Continental dependability a byword throughout the globe.

3. Continental safeguards its product's good name, and its owners' satisfaction, with established parts and service facilities wherever people fly.

The men and machines that built your engine originally are best qualified to restore it to like-new condition. Continental's Factory Remanufacture backs you with factory knowhow, and precision production machinery, throughout your engine's life. Write for information.

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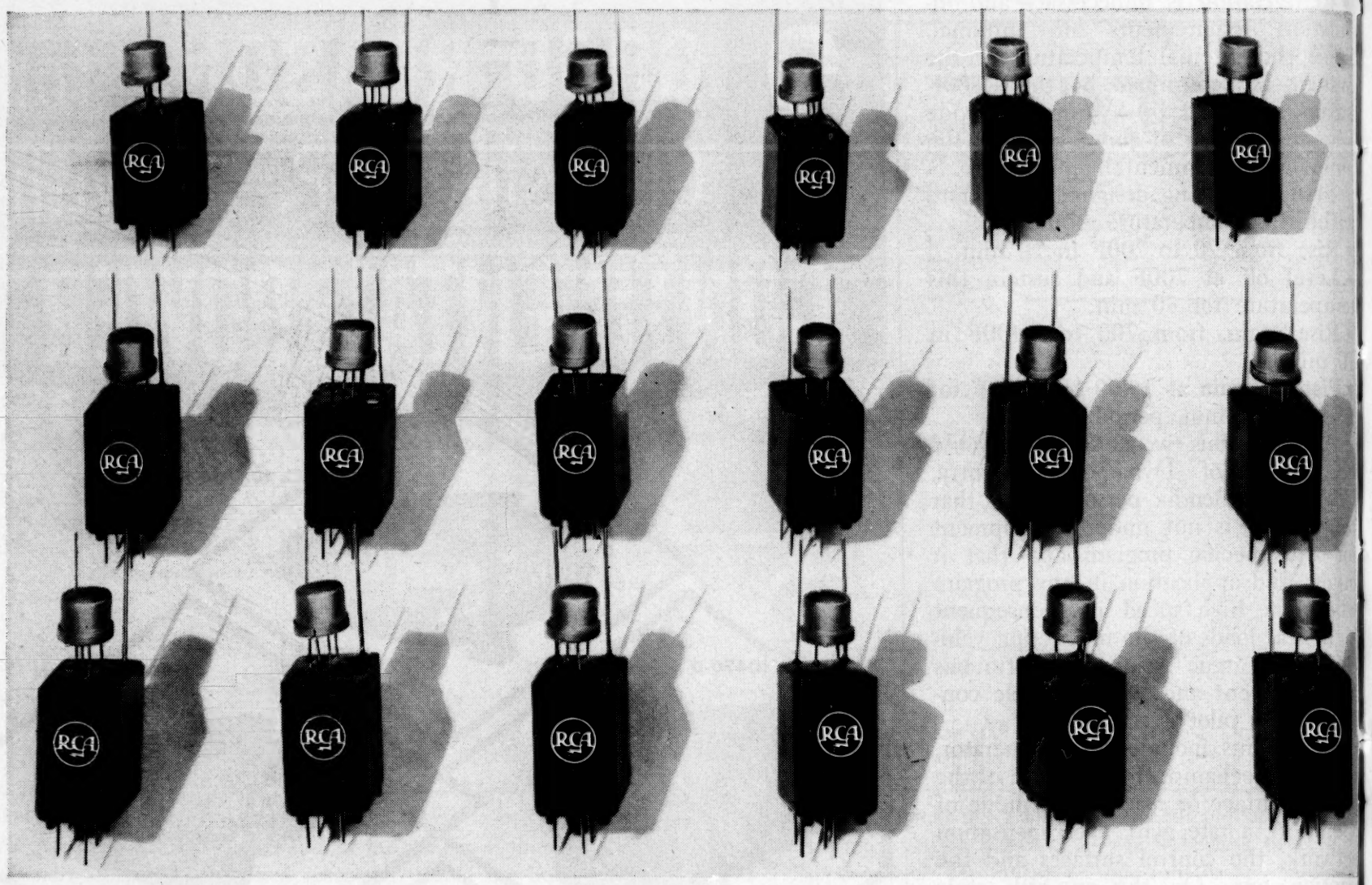


Now you can buy RCA Packaged Circuits assembled and tested to your specifications

RCA Minimodules — conventional components in high-density format — bring you today's economical answer to extra-dependable packaged transistor circuits.

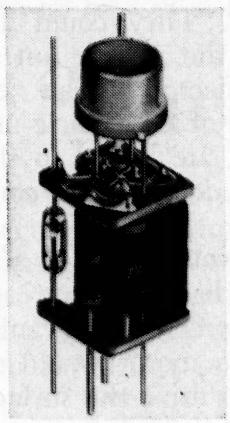
If your product calls for miniature packaged circuits . . . if your requirements include fast, high-volume availability . . . look into RCA Minimodules now.

● These high-density packaged circuit units bring you the reliability of conventional passive components, close-packed. interconnected, and encapsulated in fire-retardant epoxy-type resin to meet the mechanical and environmental requirements of MIL specifications. Standard, field-proved transistors offer you the exact characteristics your circuits need.

● RCA microelectronics specialists are ready to work with you to design your Minimodule circuit package. Typical of the 40 types now in production are four RCA Minimodules for digital-computer applications. These high-performance units, built with RCA's experience in manufacturing hundreds of thousands of digital Minimodules, are available now, ready for mounting on standard printedcircuit boards. Order these RCA Minimodules now:

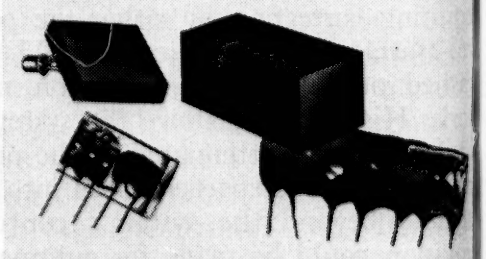
RCA CP0917 . . . Minimodule Inverter Circuit
RCA CP0918 . . . Minimodule Trigger Network
RCA CP0919 . . . Minimodule Power-Gate Input Circuit
RCA CP0920 . . . Minimodule Power-Gate Output Circuit

● Call your RCA representative for information on the comprehensive line of RCA transistor-circuit Minimodules and RCA Micromodules. Or write RCA Semiconductor and Materials Division, Commercial Engineering Section L-112-NM-2, Somerville, N. J.



RCA Minimodules – miniature packaged circuits utilizing conventional components and transistors–can be supplied in high volume, in the format you need, with terminal arrangements to meet your assembly requirements. (Minimodule shown at left, before encapsulation, 1½ times actual size. Units below are typical of wide variation in configurations available through RCA.)

For your extremely high-density applications (several hundred thousand parts per cubic foot) specify RCA Micromodules, today's only microminiature packaged circuits backed by over 55,000,000 element-hours of testing. Your RCA Field Representative is ready now to quote low, production-quantity prices for RCA Micromodules. Call him today.



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EQUIPMENT

B-70 TIRE, developed by B. F. Goodrich Co., is shown during checks after completing qualification tests at Wright-Patterson AFB, Ohio. Light color is a characteristic of the new rubber compound. Tires stacked in the background were earlier experimental models.

B-70 Tires Complete Qualification Tests

Akron, Ohio—Aircraft tire designed for USAF's B-70 Valkyrie, Mach 3 jet bomber, has successfully completed qualification tests prescribed by Air Force's Aeronautical Systems Division and North American Aviation, Inc., B-70 prime contractor.

The tire, developed by B. F. Goodrich Co. of Akron, is composed of a new rubber compound designed to withstand critical conditions imposed by the 2,000-mph. bomber's high speed, extremely heavy load and high temperature factors.

The qualification tests, conducted in an ASD laboratory at Wright-Patterson AFB, Ohio, consisted of simulated B-70 flight cycles including takeoff, flight mission and landing. During the tests, the tire was exposed to 360F temperatures for several hours between simulated takeoff and landing on a laboratory test wheel.

B. F. Goodrich engineers said that conventional tires failed a similar test before completing a single cycle. They added that the new tire is smaller and lighter than conventional aircraft tires of equivalent load capacity.

B. F. Goodrich is under contract to furnish B-70 tires to Cleveland Pneumatic Industries, designers and builders of the landing gear subsystem.

Officials of B. F. Goodrich said that some design features of the new tire, such as the ability to pack more strength and endurance into the tire's weight per pound, will have application on other aircraft and some ground vehicles.

NEW AEROSPACE PRODUCTS

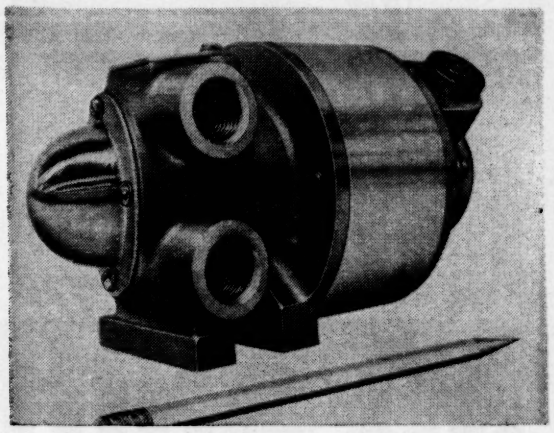
Super Nav I Omni Converter

New converter features a horizontal meter which protrudes slightly to facilitate reading from any angle. Large diameter course selector dial is numbered at 15 deg. intervals for rapid identification. Resolver type course selector is designed for 2 deg. accuracy and is rotated by a vernier drive for quick settings. The converter incorporates a to-from switch. The panel mounted unit weighs less than 2 lb. and fits a standard 3¼ in. cutout.

Skycrafters, Inc., 1365 Gladys Ave., Long Beach, Calif.

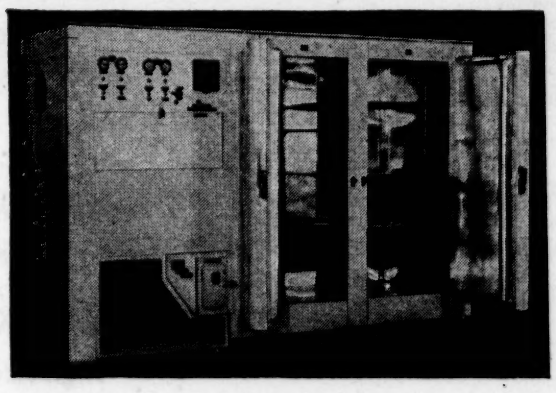
Light-Aircraft Fuel Pump

New pump is designed to meet safety and fuel provision requirements of light aircraft, delivering 35 gph. at 20 psi. and 12 v.d.c., the manufacturer reports.



Rotary, positive-displacement vane pump is driven by an integral continuous-duty motor and is said to function normally even in the presence of contaminants. Spring-loaded rotary vanes are self-adjusting to compensate for mechanical wear and to increase reliability. Manufacturer says tests indicate a life of at least 1,000 hr. before overhaul.

Burton Mfg. Co., 8910 Winnetka Ave., Northridge, Calif.



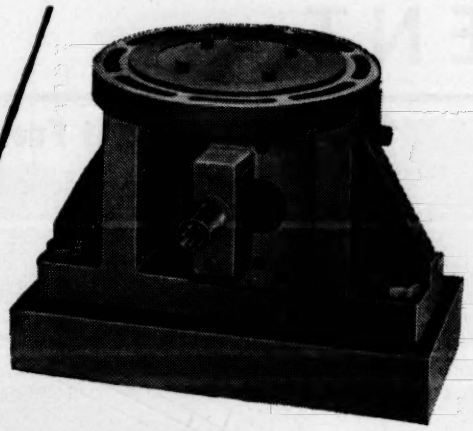
Environmental Chamber

New chamber produces temperatures down to −125F and is designed to meet military specifications for test and storage of electronic, mechanical, solid state and electro-mechanical components and cryogenic fluids.

Unit shown is the upright Model 4033-100, available in baked enamel or stainless steel exterior and measuring 130 in. long, 72 in. high and 36 in. deep. Chamber includes self-contained mechanical refrigeration, automatic defrost, adjustable shelves, 15F gradient and stainless steel interior. Models are available in capacities of 40, 80, 120 and 240 cu. ft.

Front panel instrumentation includes indicator lights, pressure and temperature gages and temperature control knob. Semi-hermetically sealed compressor is air-cooled and available in 220 v. or 440 v. on a control circuit of 115 v.

Solar Systems, Inc., 11936 Valerio St., North Hollywood, Calif.



This test stand for miniature rocket motors loaded with experimental, high impulse propellants was designed and built by FluiDyne around the Flex-Cell. Motors are directly attached to the Flex-Cell via the circular adaptor plate eliminating the need for additional alignment devices or flexures. Rated capacity is 750 pounds with overload protection to 75,000 pounds.

FORCE MEASUREMENT SYSTEMS

USING THE *FLUIDYNE* FLEX-CELL

FluiDyne force measurement systems incorporating the Flex-Cell are rugged and accurately isolate the components of force you desire to measure. Systems applications include rocket motor test stands, wind tunnel balances, jet engine test stands, and static and dynamic weight determination systems.

FLUIDYNE Systems with the FLEX-CELL Give You These Advantages:

- High Accuracy
- Negligible Interactions Between Components
- High Frequency Response
- Low Reaction to Moment Inputs
- Simplified Mounting and Alignment
- Corrosion Resistance
- Insensitivity to Ambient Pressure Changes

FluiDyne can help you develop force, pressure, temperature and optical measurement systems to fit your specific needs. For more information about the complete FluiDyne services in these areas, contact us today. For detailed information about the Flex-Cell, request Bulletin 61-2.

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If you are a graduate engineer with hypersonic, heat transfer, or controls and instrumentation experience, you are invited to investigate employment opportunities at FluiDyne. Write or phone and tell us the nature of your experience and ambitions.

FINANCIAL

New Offerings

Electro-Mec Instrument Corp., Long Island City, N. Y., engaged in the design and manufacture of potentiometers, digitometers and goniometers. Offering is 176,480 common shares by the present holder, Waltham Precision Instrument Co., Inc., at $6 per share.

Electronic Communications, Inc., St. Petersburg, Fla., engaged in the design, development and manufacture of electronic communication systems and equipment principally for airborne and surface voice communications and data link systems. Offering is 150,000 common shares. Proceeds will be added to the general funds of the company.

Pyrometer Company of America, Inc., Penndel, Pa., engaged in the design and manufacture of thermocouple temperature transducers and electronic indicating and controlling instruments, and in the processing of thermocouple wire. Offering is 300,000 common shares. The proceeds, estimated at $365,000, will be applied to the acquisition of Hamilton Manufacturing Co., Inc., including repayment of $25,000 advanced by Pyrometer's board chairman as down payment. Hamilton manufactures missile and aircraft components and assemblies.

Glass-Tite Industries, Inc., Providence, R. I., engaged in the manufacture of glass-to-metal hermetic seals used in transistors, diodes, condensers, gyroscopes, connectors, switches and transformers for the semiconductor, communications, aircraft and missile industries. Offering is 185,000 common shares; 135,000 shares for public sale by the company, and 50,000 outstanding shares by Indiana General Corp., a principal stockholder. Of the company's proceeds, $600,000 will be applied to the engineering and purchase of additional units of production and testing equipment; $500,000 to an additional investment in Burndy-Escon, Inc., a subsidiary; $150,000 to research and development in connection with certain new products; $125,000 to expenses in connection with the projected moving of the company's Rhode Island operations to a new site.

Seg Electronics Co., Inc., Brooklyn, N. Y., engaged in the design, engineering and manufacture of networks for data and program transmission, filters, transceivers and related electronic equipment. Offering is 110,000 com-

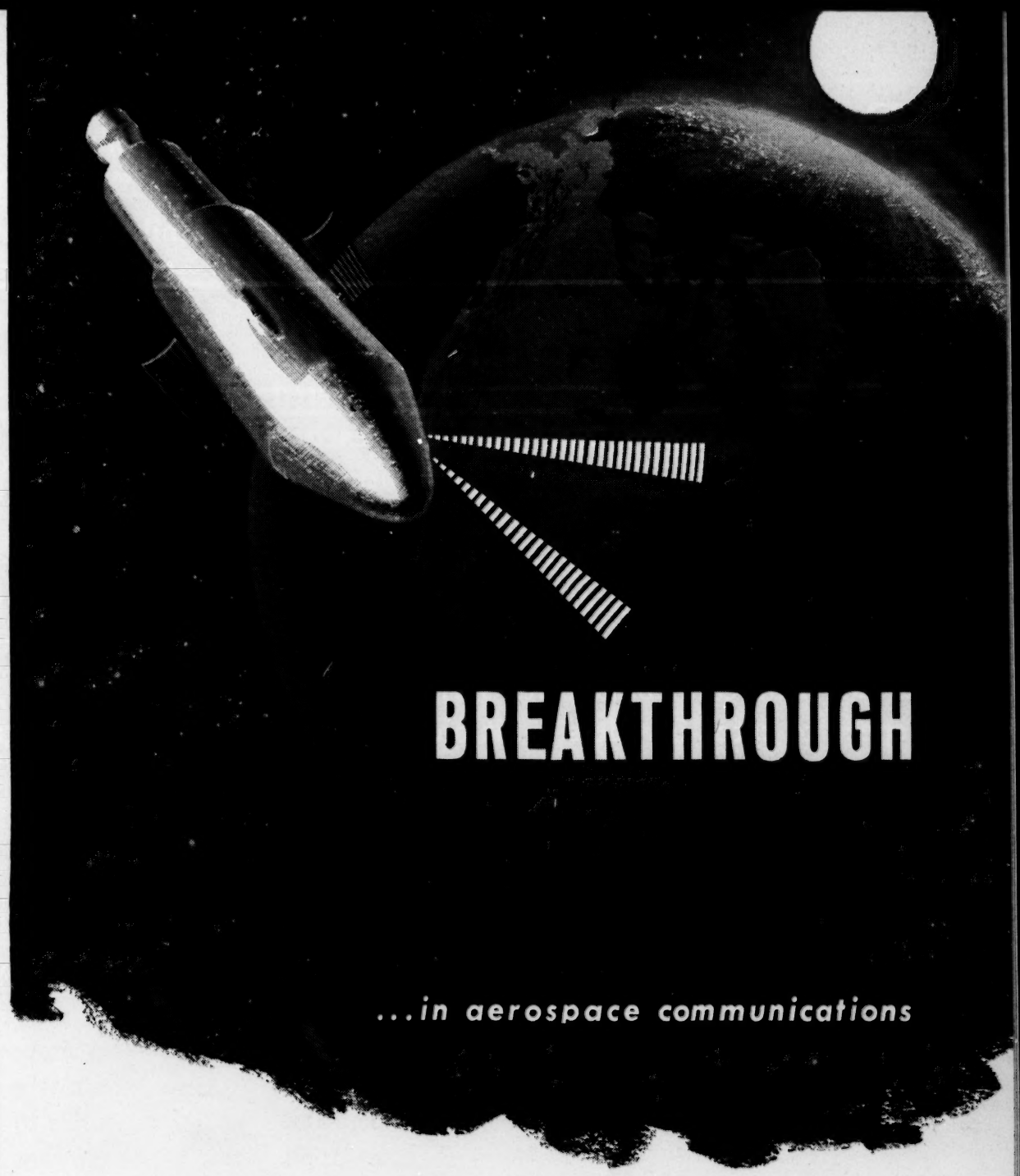
mon shares. Of the proceeds, $50,000 will be used for the purchase of additional production and testing equipment; $110,000 for research and development of additional product lines; $25,000 to repay loans from banks incurred during August and September, 1961.

IMC Magnetics Corp., Westbury, N. Y., engaged in the design, development and manufacture of nonactive components, such as instrument motors, indicating devices and allied products for military and commercial uses. Offering is $1,000,000 of outstanding 5½% convertible notes, due 1970, and 30,850 outstanding common shares by the present holders.

United Aero Products Corp., Burlington, N. J., engaged in contract manufacturing precision machined components and mechanical assemblies to customer specifications for use in the aircraft, missile, electronic and nuclear industries. Offering is $600,000 of 6% convertible subordinated debentures, due 1971, for public sale at 100% of principal amount. Proceeds will be used to repay current liabilities; to produce inventory for United Aero Products Corp., a subsidiary; for research and development and product refinement by United Aerotronics Corp., another subsidiary; to expand company facilities.

Eon Corp., Brooklyn, N. Y., organized in August, 1961, for the purpose of developing and manufacturing equipment for radiation detection and measurement, as well as other electronic and nuclear instruments and devices for sale to governmental agencies and private industry. Offering if 133,333 common shares. Of the proceeds $220,000 will be used for purchase and installation of machinery and equipment and leasehold improvements; $615,000 for working capital, including operating expenses during the preliminary period of the company's development.

International Resistance Co., Philadelphia, Pa., engaged in the manufacture of resistors and other electronic components, including choke coils, selenium rectifiers, precision potentiometers, transducers, high temperature plastic laminates for printed circuits, flexible multiconductor cable, and microcircuits. Offering is 40,000 common shares to be offered in exchange for, but not exceeding, 245,000 common shares of North American Electronics, Inc. (NAE), at the rate of one share for each five shares of NAE. NAE is engaged in designing, engineering and manufacturing silicon semiconductors and controlled rectifiers.



THE FIRST SUCCESSFUL MICROWAVE SOLID-STATE TRANSMITTER
WITH POWER CAPABILITY ADEQUATE FOR SATELLITE APPLICATION
A DEVELOPMENT BY THE SCIENTISTS AT AMHERST LABORATORIES

The objective assigned to the Amherst Laboratories' scientists was this:
Advance the state-of-the-art of microwave space vehicle transmitters by increasing performance, reducing size, reducing weight and increasing reliability.
The time was June 1960. One year later, these objectives had been reached *and exceeded by a wide margin.*
The result: a solid-state transmitter applicable for satellite use, operating within the S-band, about half the size of a carton of cigarettes, and with a life expectancy of two years.
This significant achievement is representative of many challenges currently being met by the scientists at Amherst Laboratories.

PAPER ON REQUEST: The paper which explains the new techniques employed in development of the new microwave Solid-State Transmitter authored by W. J. Maclag is available to engineers and scientists on request. Write for the paper entitled "Solid State, S-band Single Side Band Suppressed Carrier Transmitter"

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E PHANTOM II is the fastest fighter
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ecord of 1606.3 mph.
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peeds in excess of 1650 mph on the
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ombat, such speeds are required only for
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m II can cover vast distances before the
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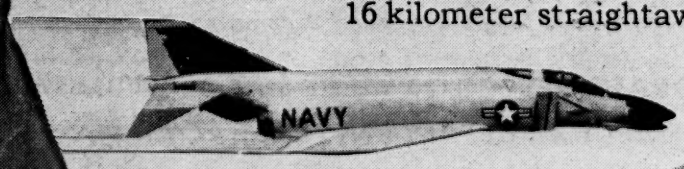
ed to catch invaders . . . it has the speed
to deliver an attack almost before radar can find it . . . and it has the speed to get away. At 26 miles a minute, it takes but 46 seconds to cross the English Channel. At 1600 miles an hour, it's less than eight minutes from New York to Boston, four minutes from Detroit to Cleveland.

The performance of the McDonnell Phantom II is matched by its armament versatility. The Phantom II can carry Sparrow III and Sidewinder missiles for air defense or air superiority missions. It can carry multi-ton loads of conventional bombs and napalm for troop support missions. It can carry nuclear stores for long range strategic attack.

at 1600 mph, the Sky is an Oven

Record Flights of the Phantom II:

Altitude	98,557 feet
100 kilometer closed course	1390 mph
500 kilometer closed course	1216 mph
Los Angeles to New York	170 minutes
3 kilometer low altitude	902 mph
16 kilometer straightaway	1606.3 mph



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AVIATION

B Accident Investigation Report:

WA 707 Lands Wheels-Up at Idlewild

May 9, 1960, at 2049 GMT, a World Airlines Boeing 707-331, 5TW, crashed "wheels up" at New International Airport. Eight of the passengers aboard received mild in- during evacuation. The aircraft sus- l major damage as a result of contact the runway and ensuing fire.

cause of a low ceiling and visibility, ach to the airport had to be accom- d on instruments. The instrument ach was poorly executed and visual ct with the runway was established the aircraft was too high and too to the runway threshold to be landed . Nevertheless, the captain continued pproach until more than one-half of vailable runway had passed beneath ircraft. When the decision was made andon the approach, a go-around was ed. Contrary to company regulations good operating procedures, the landing was raised before a positive climb had assured. The aircraft touched down he landing gear retracted. As a result ircraft settled to the runway and slid top about 500 ft. from the end.

ans World Airlines Flight 100 is a ar nonstop flight from Los Angeles, , to New York, N. Y. On the trip ay 9, 1960, there were 100 passengers a crew of nine.

e crew made normal preparations for flight which included filing an IFR plan to New York via jet routes nd 42 to cruise at 31,000 ft. The ated time en route was 4 hr. 34 min. Baltimore, Md., as an alternate air-

e maximum allowable takeoff gross t was 275,000 lb.; however, actual ff weight was 270,447 lb., including l weight of 117,000 lb. The center avity was within limits.

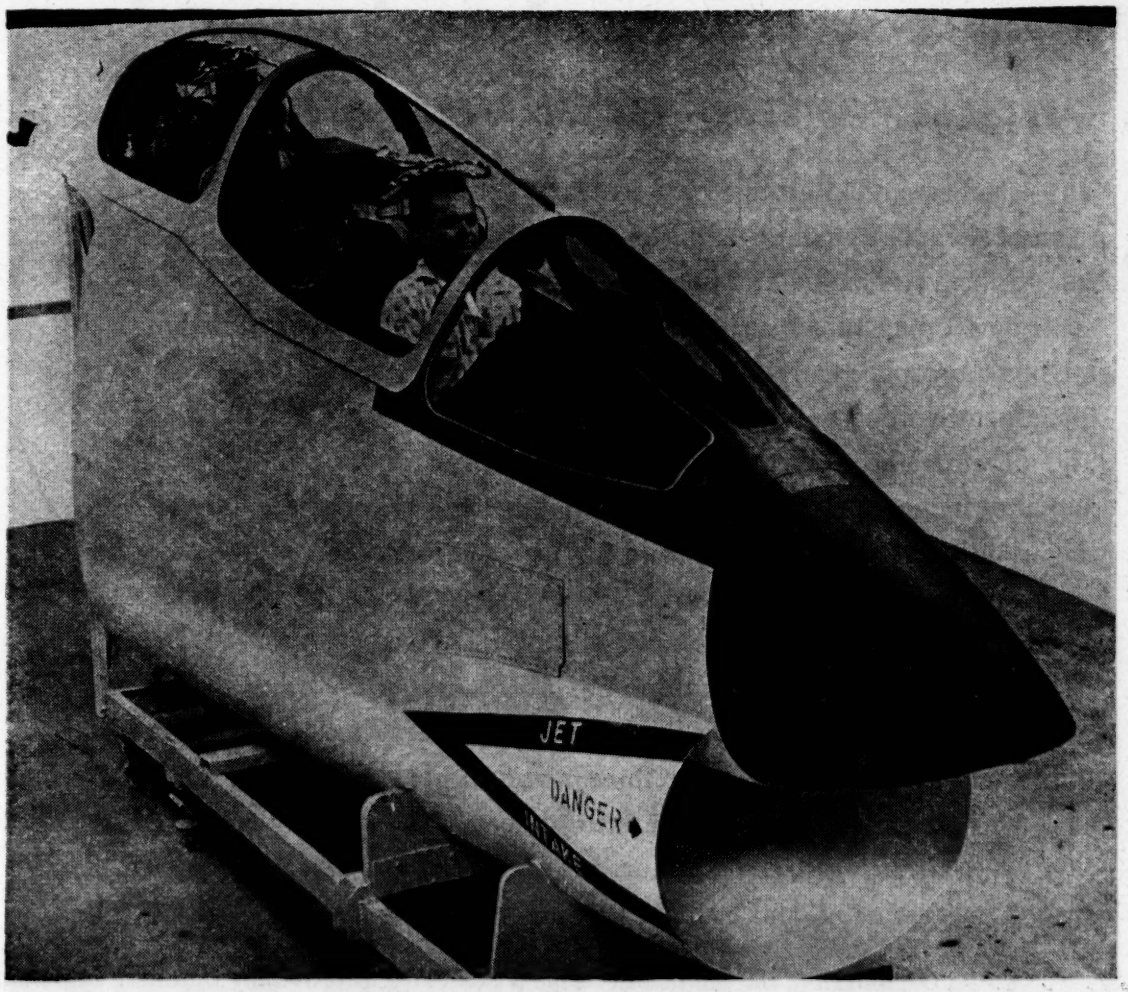
ght clearance was received and the ft departed Los Angeles International rt 1606Z[1]. It was cleared to cruise e flight plan route at 33,000 ft. The proceeded eastward normally and York center accepted a radar handoff the adjoining GCI radar site when t 100 was in the area of Front Royal, The flight was then directed into the York area and was descended in prep- on for an instrument approach to run- 22L at Idlewild.

lewild approach control then estab- l radar contact with the flight and red it to intercept the localizer course e ILS about three miles northeast of outer marker. The flight was given latest wind and altimeter setting and ed that the glide slope was inopera- The weather at the time was given e tower as ceiling measured 400 ft. variable broken, 700 ft. overcast; visibility 4 mi. in fog; wind from the south at 15 kt. altimeter setting 29.49.

Capt. Harry E. Campbell testified that the trip from Los Angeles had been routine. Descent was made on instruments in the New York area in accordance with instructions from New York center and Idlewild approach control. He said that they had been cleared to make a localizer approach, that they intercepted the localizer about two miles outside of the outer marker at an altitude of 1,500 ft., and that the aircraft was being operated in accordance with all prescribed instructions. He testified that the ILS approach was completely normal; airspeed was maintained constant at reference plus 10 kt. (141 kt.); rate of sink was maintained between 500 and 700 fpm.; and that the aircraft was on the localizer from the outer marker almost all the way down. Captain Campbell testified that he identified the outer marker by the ADF's and the flashing marker beacon light on the instrument panel but that the audible signal for the marker beacon had been turned off. He said the aircraft was being flown on autopilot; that it was on the "localizer feature" of the "automatic coupler," and that he was controlling the altitude by use of throttle. The captain said that he did not recall "hitting" the middle marker and "did not note anything that was other than the normal."

The captain further testified that the autopilot was operating properly and that there were no heading changes made during the approach but that approximately two-thirds of the distance from the outer marker to the runway, while the aircraft was on the localizer, the autopilot, for unknown reasons, disengaged.

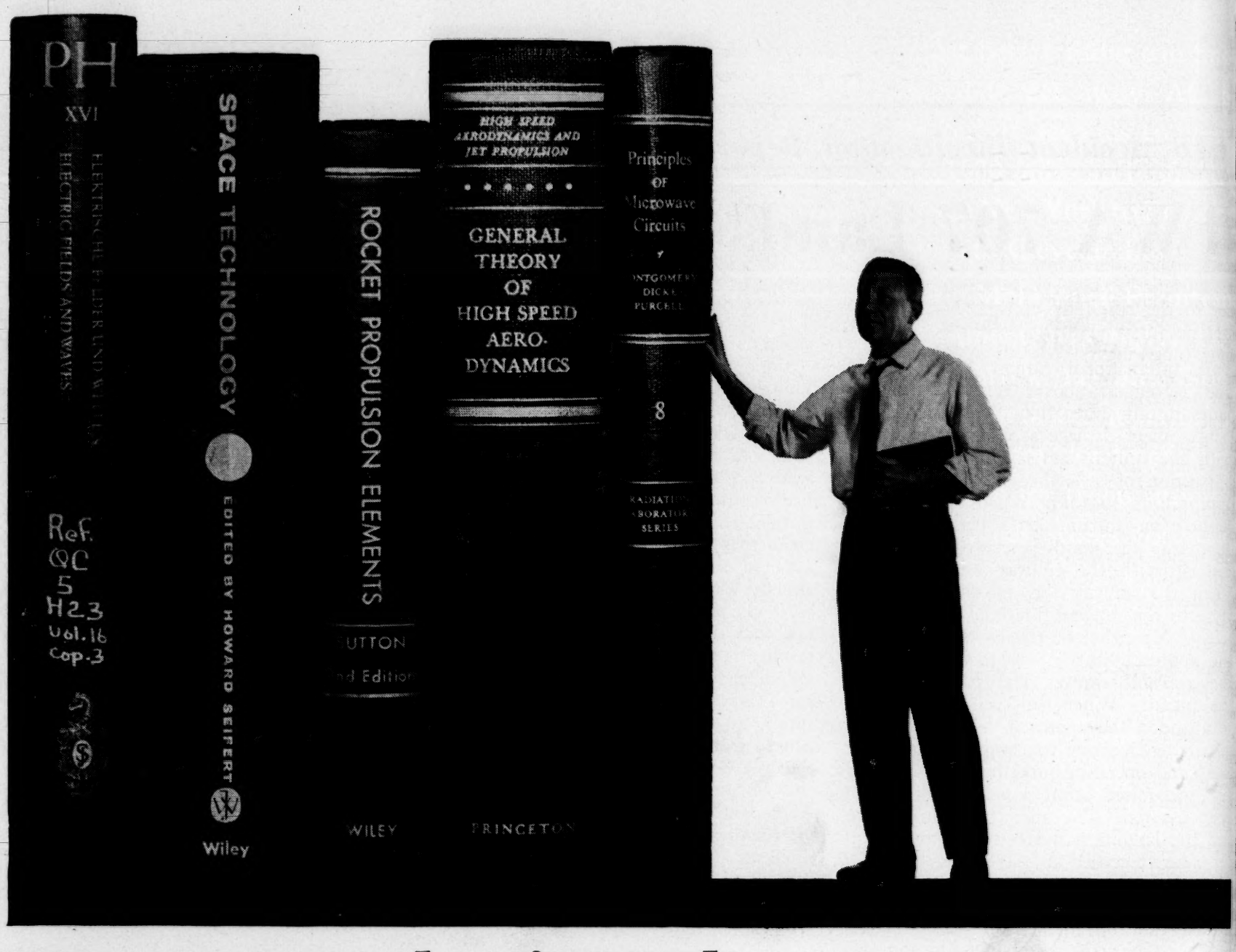
The captain further testified that he established visual contact with the runway shortly after the autopilot disengaged. At that time, he said the aircraft was about 100 ft. to the right of the runway and between 500 and 1,000 ft. from the threshold at an altitude of approximately 400 ft. After dropping full flaps he had to "S" the aircraft to line up with the runway. Approximately half way down the runway and at an altitude of "about 50 ft. or perhaps less" he said he decided to abandon the landing and go around. He advanced the power to approximately 2.0/2.30 EPR and gave the command for 30 deg. of flaps and for the gear to be raised. He also said that



Vought Builds Mockup of F8U-1T Trainer

Mockup of Chance Vought F8U-1T trainer version of the single-place carrier-based F8U fighter shows two-place cockpit, which will be equipped with dual controls. Canopy is about 15 in. higher than fighter version to provide instructor in rear seat with good visibility over student's head. Speed will be about Mach 1.5.

All times herein are Greenwich mean based on the 24-hr clock; all altitudes mean sea level.



space systems planning and engineering in a unique role

The scientists and engineers of Aerospace Corporation are in the forefront of advanced planning and general systems engineering. Their unique role: critical civilian link uniting government and the scientific-industrial team developing space systems and advanced ballistic missiles. In this mission Aerospace Corporation provides advanced systems analysis and planning, theoretical and experimental research, initial systems engineering, initial technical direction and general technical supervision. Specific activities include investigation of techniques for improving the state-of-the-art in propulsion, structures, guidance, communications and other engineering skills related to missile/space missions; feasibility studies of new weapons systems concepts and preliminary design of promising systems; formulation of development programs; conduct of critical experiments; technical supervision of the development and test program. Immediate assignments exist for those highly skilled in these specialties and who are knowledgeable in inter-disciplinary problem solving. Men with advanced degrees are urged to contact Mr. Herndon, Aerospace Corporation, Room 101, P.O. Box 95081, Los Angeles 45, Calif.

Organized in the public interest and dedicated to providing objective leadership in the advancement and application of space science and technology for the United States Government.

AEROSPACE CORPORATION

ALL QUALIFIED APPLICANTS WILL RECEIVE CONSIDERATION FOR EMPLOYMENT WITHOUT REGARD TO RACE, CREED, COLOR OR NATIONAL ORIGIN.

at the time the command was given to raise the gear the aircraft was to the best of his knowledge in a climbing attitude. When asked if the aircraft was climbing he replied, "We were on the runway."

The captain said he did not see the approach lights during the approach. Then, in answer to a question of what possible factors could have contributed to his "overshoot," Capt. Campbell said, "One, no approach lights. Two, no glide path. Three, the automatic pilot became disengaged prior to the threshold of the runway." It might be noted here that the runway lights, narrow-gauge lights, centerline lights, and the high-speed taxi lights are operated from a panel in the control tower cab. Included in the control panel is a monitoring system which indicates when the power for the various lighting systems is on and if the lights are functioning properly. The monitoring system will also indicate by a warning light and buzzer if any one of the lanes is not operating properly. Testimony of the tower personnel indicated that all the systems were in operation and no outages or failures in the systems were indicated.

Capt. Campbell said that immediately after touchdown he heard the landing gear unsafe warning horn and immediately closed the throttles. The airplane settled to the runway and slid to a stop with all three landing gears retracted. He said there was a fire warning signal for engines Nos. 2 and 3 and that he cut off the start levers with the exception of No. 3 which was jammed. He saw that the first officer had started to activate the fire bottles on Nos. 2 and 3 engines but he did not observe whether the bottles were actuated.

First Officer Horace E. Nichols testified substantially the same as Capt. Campbell that the flight approach into the New York area was completely normal.

Approach Speed

He stated that the approach speed of the aircraft was constant from the outer marker inbound at reference plus 10 kt. Also that the rate of descent was normal; approximately 500 fpm.

Nichols testified that he noted passage of the outer marker by the ADF needles but could not see the flashing marker beacon because it is located on the other side of the cockpit. He also testified that he did not identify the middle marker because they were contact before reaching it. He said, "I say we were contact better —half a mile from the end of the runway or a little better and this is purely judgment." He then stated that the middle marker was located five-tenths of a mile from the end of the runway. (The location of the middle marker for runway 22L is actually six-tenths nautical miles from the runway threshold.)

Nichols also said that just before becoming contact he "sensed" the airplane had started a slight right turn and out of the corner of his eye he could see the automatic pilot disengage warning light flashing. This warning light is located on the lower left side of the center instrument panel. It is below and slightly to the right of the airways marker beacon light.

Visual contact was established two or three seconds later and, according to Nichols, the aircraft was about 150 ft. to

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the right of the runway centerline and at an altitude of 450 ft. He said Capt. Campbell lined the aircraft up with the runway and continued the approach. He could not estimate the altitude of the aircraft as it crossed the threshold but did say it was approximately 50 to 75 ft. in the air and halfway down the runway when the captain initiated a "go-around." He said the captain told him they were going around, applied power, and ordered 30 deg. of flaps and gear up. Mr. Nichols stated that upon the captain's order he raised the flap handle to the 30-deg. position, noted that the indicator began to move, and then raised the landing gear handle to the up position. He said he did not know whether the aircraft was still descending when he raised the gear because he was occupied with checking the flap and gear indications and was not looking out of the cockpit.

Nichols stated that the landing gear warning horn did not sound until the aircraft contacted the runway. As the aircraft slid to a halt the fire warning sounded for engines Nos. 2 and 3. Mr. Nichols stated that he armed the fire selectors for these engines but that as he was about to actuate the extinguisher all electrical power went off the airplane.

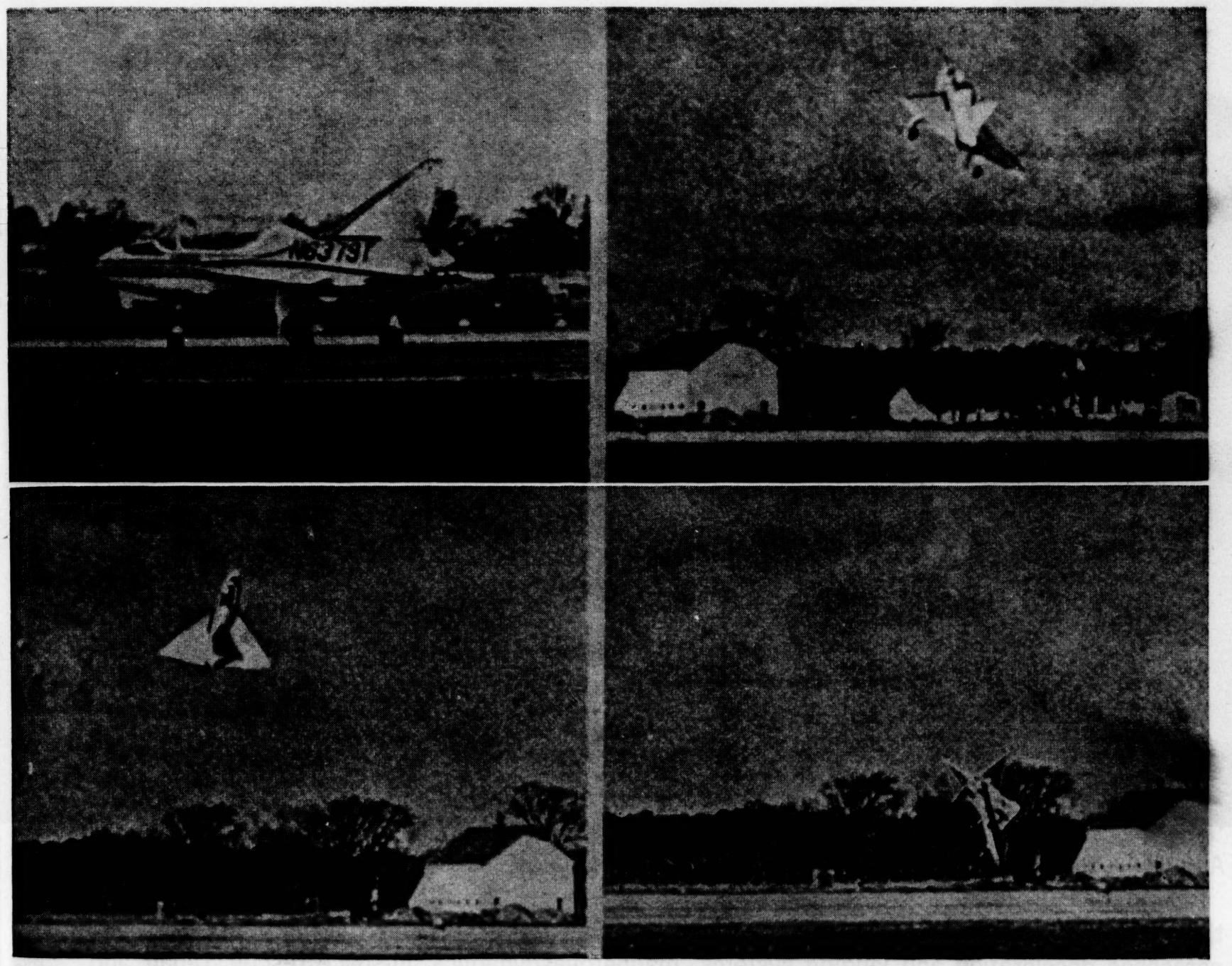
The flight engineer, Outhwaite, stated that he heard the fire warning bell sound as the aircraft was sliding on the runway. After coming to rest he said he heard someone say that there was a fire in No. 2. Mr. Outhwaite said before leaving the cockpit he secured the flight engineer's panel in accordance with company procedures for anticipated crash landings by turning off every switch he could find, including the battery switch. Turning the battery switch off interrupts power to the d. c. bus and makes it impossible to actuate the fire extinguishers.

At the time of the accident, the TWA emergency checklist called for turning the battery switch off prior to landing when a crash landing or ditching was anticipated. Action was initiated immediately, after the accident to revise the fire extinguishing system circuits and remove them from d. c. bus.

This would permit the utilization of a "hot" circuit to this system which can then be actuated either automatically or manually. As a temporary measure the battery switch item has been removed from the current emergency checklist and thus will not be turned off for an anticipated crash landing.

After the aircraft came to rest, evacuation of the passengers was accomplished quickly but with some difficulty. The left front passenger loading door was opened by the captain and first officer and the emergency chute was lowered. It would not inflate so the captain, first officer, and two male passengers descended to the ground and held the chute secure. About 25 or 30 persons left the aircraft by this exit.

The right front (forward galley) door was opened and after some difficulty the emergency chute was properly secured in place and inflated. It was estimated that about 25 to 30 persons left by this exit. The two hostesses seated in the aft section of the aircraft opened the right rear (rear galley) door after observing fire on the left side of the aircraft. Several male passengers who had deplaned via the over-the-wing emergency exits were outside the door and



Homebuilt Aircraft Crashes on First Flight, Killing Owner

Homebuilt pusher aircraft crashes on first flight at Flint, Mich., fatally injuring Herbert Dean, who designed the aircraft and had a scale model tested in the University of Michigan wind tunnel. At top left, aircraft is taking off. At top right, it climbs steeply toward the right, but picture indicates elevators are deflected to hold nose down and ailerons are deflected for roll to the left. At bottom left, the Delt-Air 250 is apparently falling tail-first out of control in what appears to be the beginning of a stall. Nose-down elevator and left aileron apparently are still being applied. At bottom right, plane has swung rapidly to a steep nose-down attitude and is almost in contact with ground.

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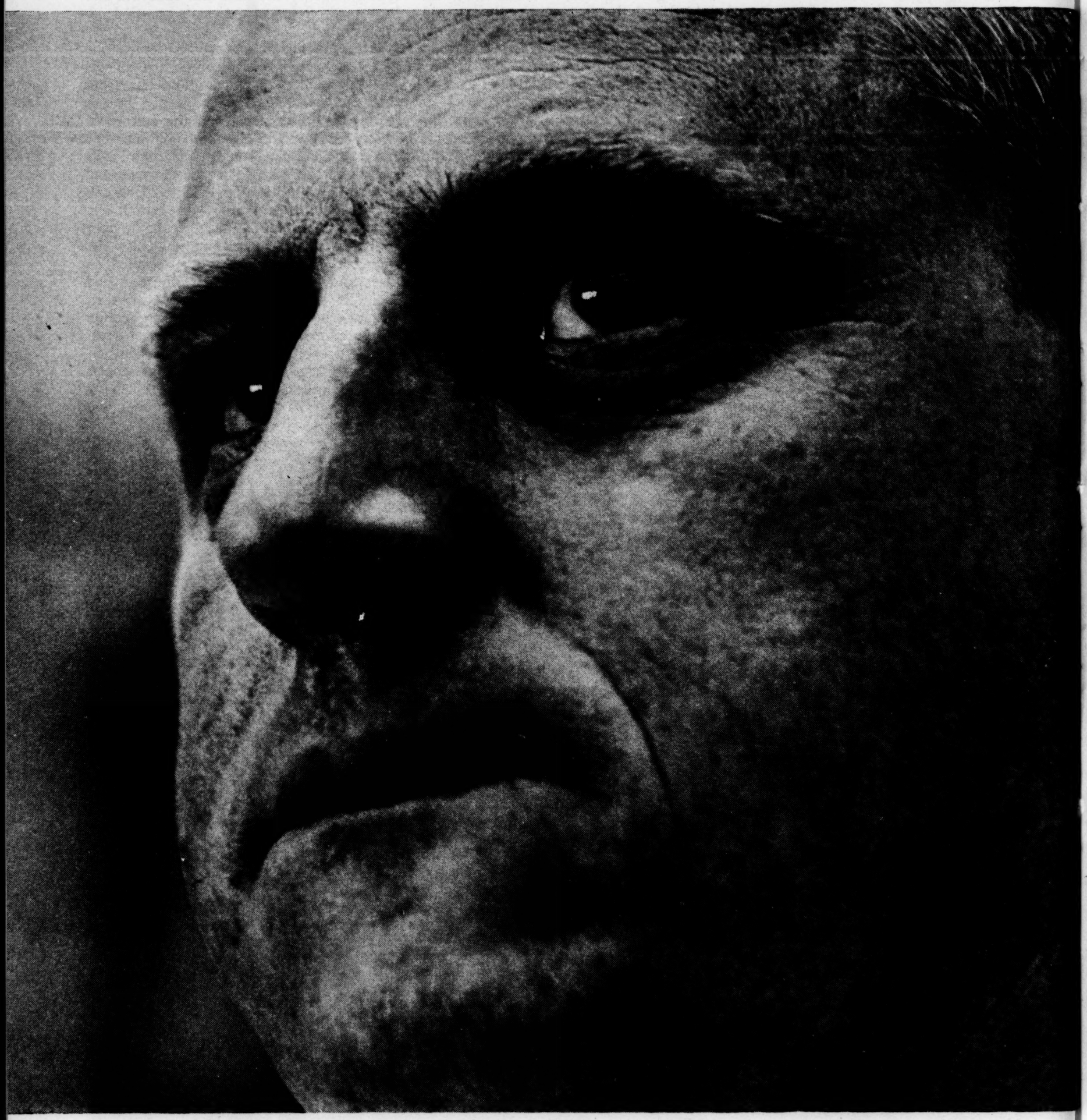

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assisted approximately 45 to 50 passengers to the ground. The emergency chute was not needed at this exit and no attempt was made to use it.

Firefighting equipment arrived at the aircraft promptly and immediately extinguished fires which had developed on engines Nos. 2 and 3.

Eight of the passengers received minor or comparatively minor injuries during the evacuation.

Structural Damage

All structural damage to the aircraft resulted from the aircraft sliding along the runway on its fuselage belly. Examination also revealed that the damage sustained by the Nos. 2 and 3 powerplants was the result of this contact with the runway and the ensuing fire. Powerplants Nos. 1 and 4 were undamaged. As a result of crew testimony and examination of the engines, all four were determined to have been capable of normal operation prior to the time of the accident.

All the aircraft systems were checked and found to be operating normally. In addition, no evidence could be found to indicate a malfunction in the autopilot. (It is noted in the aircraft operating manual that actuation of the electric stabilizer trim thumb switch will disconnect the autopilot.)

The aircraft was equipped with a flight recorder which was operating properly during the accident. The tape covering the last portion of the flight was read and found to contain rather significant information. Airspeed was found to have been about 165 kt. at the outer marker inbound. It then increased to about 170 kt., for a period of about one minute. It then began to decrease to approximately 141 kt. at the middle marker; then to about 128 kt. at the first point of touchdown.

The acceleration trace indicated slight turbulence throughout the approach and a series of heavy accelerations at runway contact with several indicated peak loads of 3.2 and 4.2 gs.

The heading trace from the outer marker inbound was extremely erratic. The aircraft heading varied almost 30 deg. during the approach.

The altitude recording and rates of descent calculated from it were also very significant. The aircraft crossed the outer marker at an altitude of about 1,200 ft. Its rate of descent during the next minute was approximately 100 fpm. The rate of descent then increased to about 1,200 fpm. and the aircraft descended to about 650 ft. The descent continued at a much lesser rate for a short period and the aircraft then began a gentle climb as it reached the vicinity of the middle marker. Shortly after this the airplane was again dived at a rate of at least 1,000 fpm. until it contacted the runway.

Training Program

A TWA spokesman stated that the training program for checkout in the 707 consisted of three weeks of ground school, 12 hr. at the controls of the simulator with approximately the same amount of time as observer, and a minimum of 8 hr. of transition time in the aircraft followed by an FAA rating check ride. He said however that these are minimum times and that the company experience in qualifying over 160 captains is that an average flight time of about 20½ hr. in the aircraft and 14 to 15 hr. of simulator time is actually required for checkout.

During this time, he stated, considerable instruction and practice in standard go-around techniques is given to every captain but that most rejected landings would be given from ILS approaches at an altitude of about 200 feet or more. The procedure taught is: Advance power to take off thrust; retract flaps to 30 deg.; retract landing gear after positive rate of climb is assured. Since the accident, the witness said that the company has reemphasized that the landing gear is not to be raised until a positive rate of climb is assured.

The operations manual also cautions against the use of 50 deg. (full) flaps to correct for a high approach as excessive rates of sink might develop.

He also testified that company procedures prohibited the use of autopilot after passing the outer marker inbound if any component of the ILS is inoperative.

Analysis

Nothing was found during the investigation of this accident which would indicate a failure or malfunction of the aircraft, its powerplants, or systems. In addition the crew members stated that the flight had been routine and that no discrepancies or malfunctions had been encountered. The flight recorder was also found to operate normally subsequent to the accident. It was also recalibrated and found to be accurate within tolerances prescribed by civil air regulations.

No substantiating evidence was found to indicate a malfunction in the autopilot or to account for its disengagement as reported by the captain. Even so the alleged malfunction should not have affected the captain's ability to continue his approach successfully. By the captain's own testimony the aircraft was on the localizer centerline when the disengagement occurred. The copilot's statement that he sensed a slight right turn is the only indication of any deviation from the flightpath as a result of the reported disengagement. The Board cannot therefore attach any significance to a malfunction such as was reported.

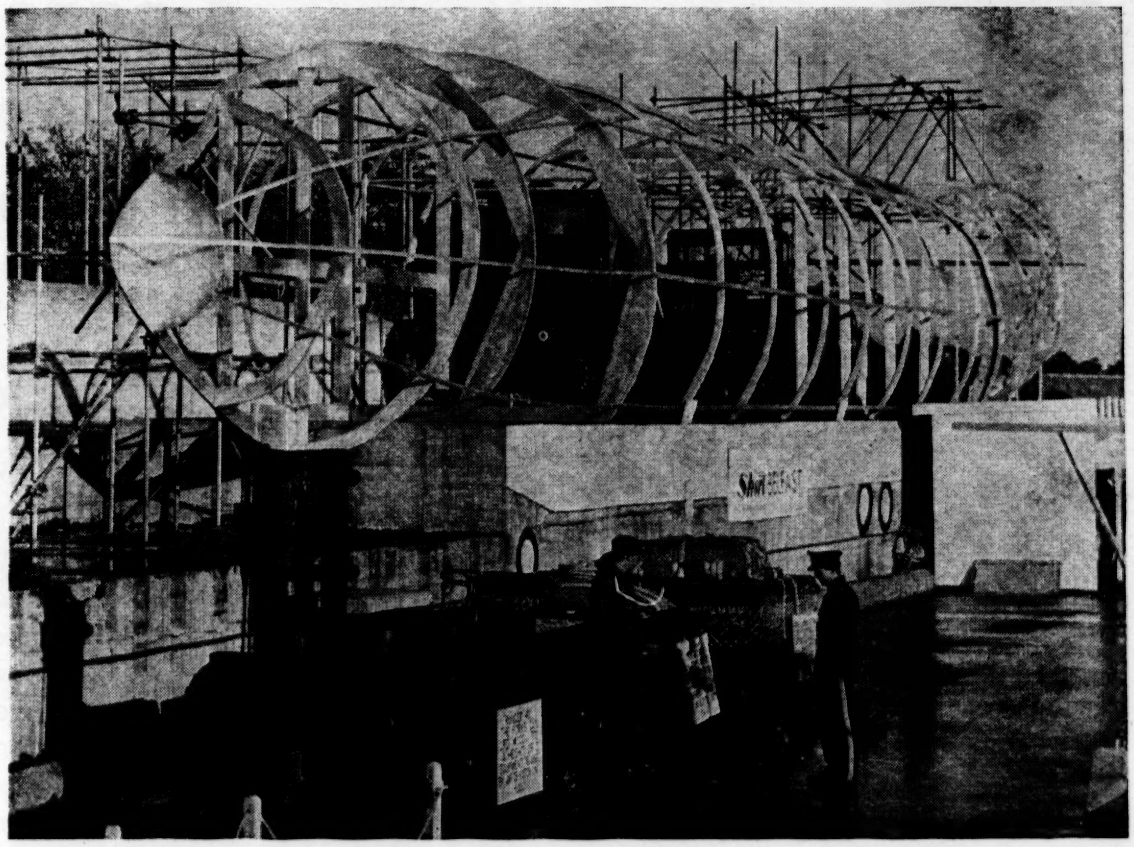
Captain's Testimony

As for the captain's testimony concerning the three factors cited to account for his overshooting the runway, the Board cannot agree that these should have had any serious adverse effects on the completion of a properly executed instrument approach. The malfunction of the autopilot has been discussed above. In addition, company regulations prohibit use of the automatic pilot for a coupled instrument approach when no glide slope is available.

The captain's allegation that the approach lights were not in operation appears to be unfounded. No outage was recorded and numerous aircraft had made similar approaches immediately preceding Flight 100. Also, although the Board does not downgrade the importance or usefulness of approach lighting systems it does believe that this approach should have been completed successfully even without such assistance. Even though the sky was overcast it was daylight and there was adequate light; visibility was about four miles.

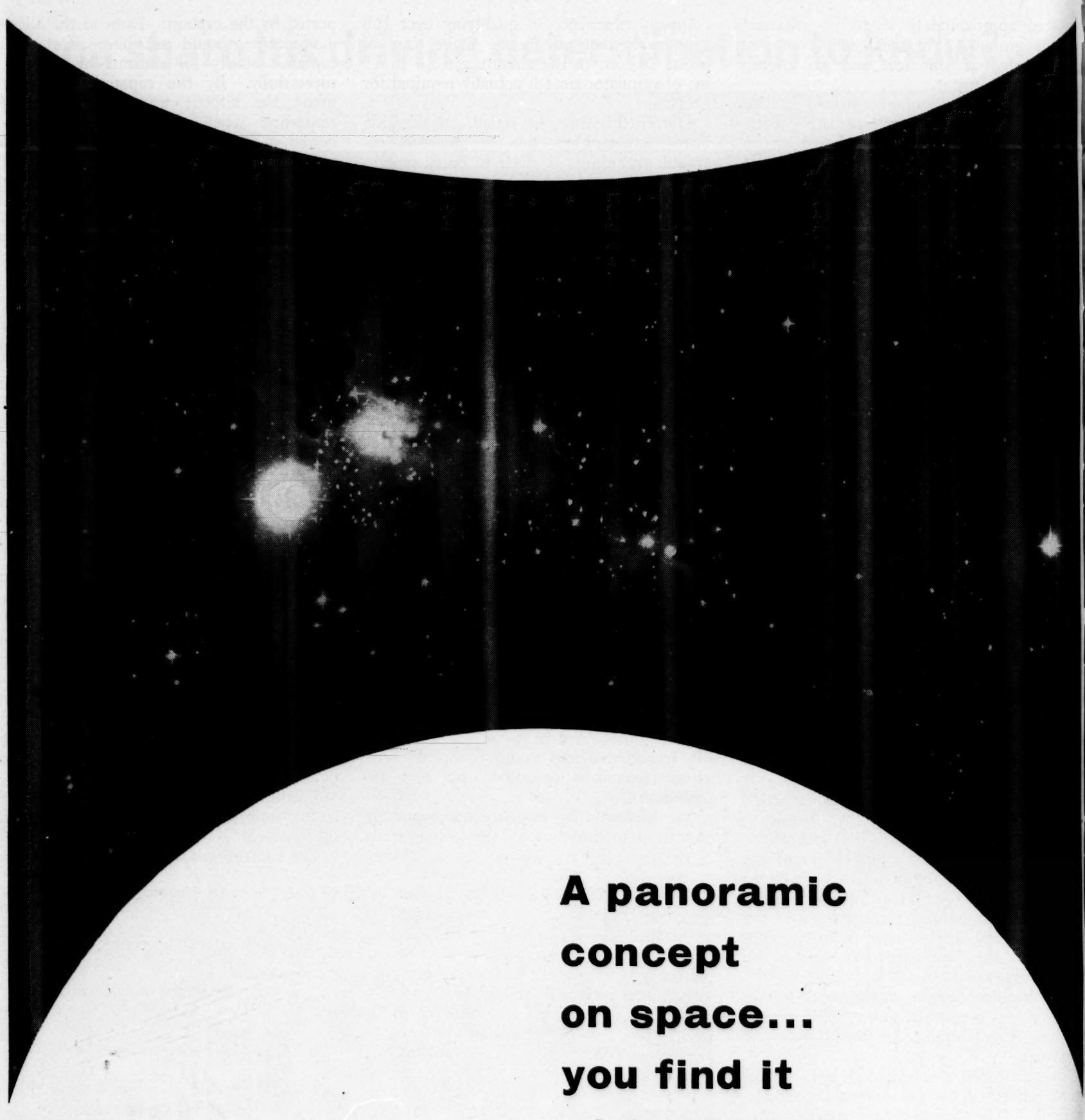
Further, the crew stated the runway was visible immediately upon breaking out of the clouds.

The captain was well aware that no glide



Mockup Built of Belfast Freighter

Fuselage mockup of the Short Belfast turboprop freighter now being built for Royal Air Force was built for British Army to use at the Fighting Vehicles Research & Development Center, Chobham, Surrey. Mockup will be used for Army loading trials; in this photo hold contains a grader, tractor, compressor and scraper blade, for a payload of 79,000 lb. Hold is 63 ft. long and 12 ft. square.



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slope was available on this runway and should have set up a constant rate of descent which would have brought the aircraft down its approach so as to break out of the overcast at the proper point. If the captain had felt that executing an instrument approach without a glide slope was not completely safe then his only action should have been to proceed to his alternate where a safe approach could be made.

The flight path of this aircraft from the outer marker inbound was extremely erratic. It is difficult to believe that the autopilot was ever even engaged unless it was malfunctioning all the way down the localizer. Heading changes of more than 20 deg. and rapid altitude changes such as are evidenced from the flight recorder readout could not have occurred unless this were true. However, the crew was unanimous in stating that no malfunction occurred prior to the disengagement two-thirds of the way down the approach. Further, these extreme readings were not a result of a malfunction of the flight recorder as it operated normally after the accident. From this evidence it appears that the aircraft was flown by hand or that it was on autopilot but being controlled by the pilot by means of the autopilot turn and pitch controllers. All the evidence indicates a lack of competency in the equipment and a lack of instrument proficiency.

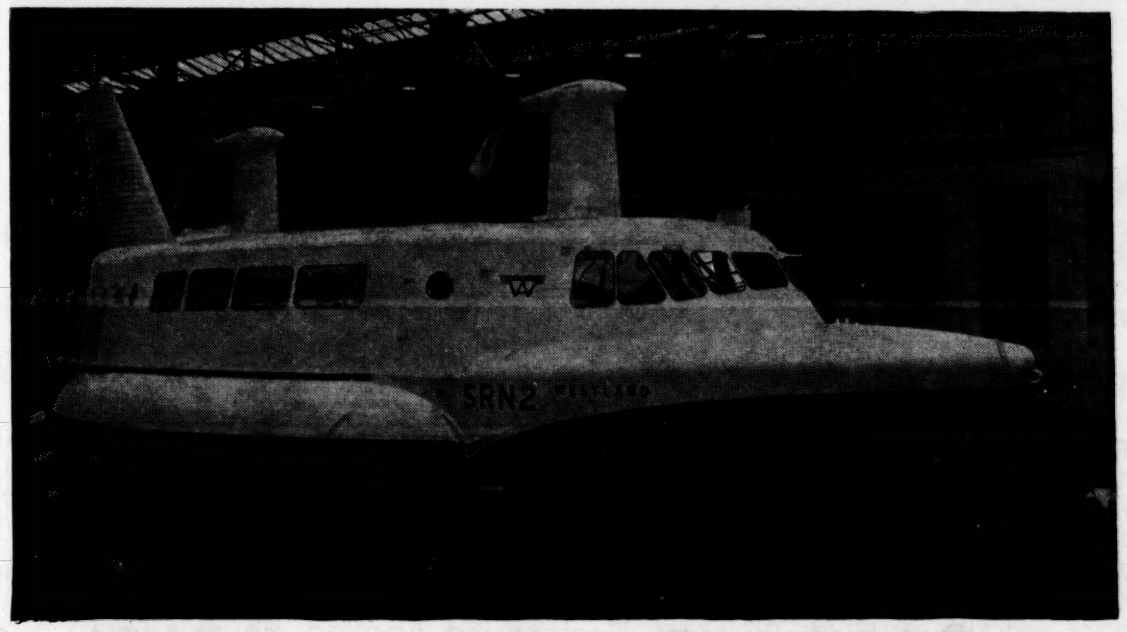
With a properly executed approach, this aircraft should have broken out of the overcast at an altitude of approximately 400 ft. (about 20 seconds), or almost eight-tenths of a mile, before reaching the middle marker. At this point the runway would have been visible and the landing could have been made successfully. It is obvious to the Board that the approach was not executed in this manner.

Immediately upon breaking contact it should have been obvious to the crew that the aircraft was too high and too close to the runway and that the approach should have been abandoned. From the position described by the captain, a flightpath of 21 deg. from the horizontal would have been required to land at the beginning of the runway. From the position described by the copilot, a flightpath of about 9 deg. would have been required. A normal approach would result in a glidepath of around 2-4 deg.

High Altitude Cited

It is also evident that the captain continued his approach despite the fact that he was at an altitude of about 275 ft. over the threshold. If it was not obvious to the crew that a go-around would be necessary when they first became contact, it most certainly should have been evident when they crossed the threshold at this extreme height.

In spite of this the captain continued his approach until approximately one-half of the runway was behind him. Then at an altitude of about 50 ft. he initiated a go-around. Again the technique employed by the captain indicates a complete lack of proficiency with the equipment. The captain advanced the power levers, called for 30 deg. of flaps, and gear up. Instead of applying takeoff thrust, as called for in the go-around procedure, he advanced the throttles to approximately 2.0/2.3 EPR.



SRN.2 Hovercraft Nears Operational Tests

Westland SRN.2 Hovercraft is undergoing preliminary engine runup tests and will start operational testing upon completion. Powerplants are two 4,815 hp. Blackburn Nimbus gas turbines, which company says will provide a cruise speed of up to 80 mph. The Westland Hovercraft weighs approximately 27 tons, according to the company.

At 125 kt. this would result in about 12,450 lb. of thrust per engine. Under conditions existing on that day, the takeoff power setting of 2.55 EPR would have been available which would produce 14,730 lb. of thrust. Actually the airplane performance at 2.30 EPR would be good and a go-around possible; however, at 2.55 EPR it is probable that less altiude would have been lost during rotation to climb attitude and before a positive climb would have been effected.

It is also apparent that the captain did not make certain that a positive rate of climb had been established before ordering the landing gear retracted. This is a specific requirement in the go-around procedure and is spelled out in the operations manual. In addition, it is just good common sense to make certain the airplane is not going to touch down before retracting the landing gear.

Inasmuch as a normal go-around is not an emergency, the normal procedures set out in the aircraft manuals should be followed. The copilot who actually performs the duty should make certain the aircraft is climbing and will not touch down before he moves the gear handle. He has a responsibility in the safe operation of the aircraft and should at least call to the attention of the captain any dangerous situation of which he is aware. It appears to the Board that the copilot, as well as the captain, should have been aware that the aircraft was not climbing out when the gear was retracted. The duties the copilot was performing were not so arduous as to prevent him from ensuring that a positive rate of climb had been established.

Conclusions

It is the Board's conclusion that there was no mechanical failure of the aircraft or its systems which contributed to the cause of this accident. The Board also concludes that the instrument approach was executed improperly. As a result, the crew established visual contact at a point too high and too close to the runway to effect a normal landing. It should have been obvious to the captain immediately that a go-around would be necessary; however, he continued his approach over one-half of the distance down the runway before attempting to go around.

The Board further concludes that the techniques employed by the captain in abandoning his landing attempt were contrary to company rules and procedures and were improper. It is obvious that a positive rate of climb did not exist when the landing gear was retracted and further that none of the pilots was properly attentive to the conditions existing.

The Board is greatly concerned about the conduct of this flight. The evidence adduced during the investigation indicates a lack of training and competence in the aircraft which cannot be overlooked. Several items, which have been previously mentioned, seem to substantiate the Board's conclusion on this matter. First, the captain said he was utilizing the VOR-LOC mode of the autopilot even though he knew there was no glide slope signal. This is directly contrary to company regulations. Second, the altitude of the aircraft at the outer marker was 1,200 ft. Minimum authorized altitude at that point is 1,500 ft. Third, the aircraft airspeed varied considerably from that described by the crew members. Fourth, both the rate of descent and the aircraft heading varied dangerously despite the testimony of the crew. Fifth, the application of power was made with little regard to established procedures with the result that takeoff power was not used for the go-around.

Sixth, the captain ordered the landing gear retracted prematurely and the copilot complied despite the fact that the aircraft was still descending.

Probable Cause

The Board determines the probable cause of this accident was a poorly conducted instrument approach necessitating a go-around which was initiated too late and improperly executed.

By the Civil Aeronautics Board:

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fied of this accident on May 9, 1960. An investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958. The taking of depositions was ordered by the Board and conducted in the Federal Building, New York International Airport, New York, N. Y., on June 15, 1960.

Flight Personnel

Capt. Harry E. Campbell, age 55, was employed by Trans World Airlines on May 10, 1929, and was promoted to captain in September of that year. He holds a valid Federal Aviation Agency airline transport pilot certificate with ratings in the Lockheed Constellation, Boeing 707-100 and 300 series aircraft, and also has a multiengine land rating.

Capt. Campbell has logged flying time in excess of 27,000 hr. of which approximately 750 hr. are in the Boeing 707. His latest FAA Class I physical examination was given on Nov. 30, 1959. He was given a line check by a company pilot on Jan. 25 and 26, 1960; given an instrument check on Jan. 12, 1960; and on that same day, given a review on emergency equipment. While in training, Capt. Campbell had accumulated 29:45 hr. flying time in the Boeing 707.

First Officer Horace E. Nichols, age 40, was employed by Trans World Airlines on Oct. 3, 1947, and was promoted to captain on Mar. 25, 1957. He holds an airline transport pilot certificate with ratings in the Lockheed Constellation and Martin 202 and 404 aircraft plus single and multiengine land ratings. He has logged a total of 15,765 flying hours with 867 hr. in the Boeing 707.

He received five hours training time in the Boeing 707; but has logged no instrument time in the aircraft.

Nichols' last line check by a company pilot was Feb. 27, 1960, and his six-month instrument check was on Feb. 12, 1960. He had a review of emergency equipment on Feb. 12, 1960.

Second Officer Louis F. Gorczyca, age 29, was employed by Trans World Airlines on Oct. 8, 1956, and was promoted to copilot on Nov. 26, 1956. His total flying time is 1,695 hr. (exclusive of military time) and he has logged 685 hr. in the Boeing 707; however, he has had one hour at the controls of that aircraft—this hour was acquired in training.

Gorczyca holds a valid commercial pilot certificate with single and multiengine land rating, instrument rating and type rating in the Lockheed Constellation aircraft. He completed a line check given by a company pilot on Feb. 27, 1960, and the date of his last six-month instrument check was Feb. 12, 1960.

He had an emergency equipment review on Nov. 8, 1959.

Flight Engineer

Flight Engineer Mark W. Outhwaite, age 49, was employed by Trans World Airlines on June 12, 1941, and promoted to flight engineer on July 28, 1943. He has a total of 11,431 flying hours and 143 hr. in the Boeing 707.

Outhwaite holds a valid FAA flight engineer certificate and an airframe and powerplant mechanic certificate. His last line check was completed on Mar. 22, 1960, and he reviewed the emergency equipment procedures on Feb. 26, 1960.

The Carrier

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This corporation holds a current certificate of public convenience and necessity for scheduled and non-scheduled operations, and possesses valid air carrier operating certificates for these operations.

The Aircraft

The aircraft was a Boeing 707, model 331 Intercontinental, United States Registry No. N-765TW owned by the Hughes Tool Company and operated by Trans World Airlines. It bears a date of manufacture of Jan. 18, 1960, and manufacturer's serial number 17679. The total time on the airframe was 943:12.

The entire aircraft had received it No. 5 line maintenance inspection 38:16 hr. prior to the accident.

The engines were Pratt and Whitney Model JT 4A-9 dual axial compressor turbojet engines. Number 1 engine had 242:37; No. 2 had 38:16; No. 3 had 658:41; and No. 4 had 38.16 time since the engine's last overhaul.

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PROBLEMATICAL RECREATIONS 96

Four boys, Alan, Brian, Charles and Donald, and four girls, Eve, Fay, Gwen and Helen are each in love with one of the others, and, sad to say, in no case is their love requited. Alan loves the girl who loves the man who loves Eve. Fay is loved by the man who is loved by the girl loved by Brian. Charles loves the girl who loves Donald. If Brian is not loved by Gwen, and the boy who is loved by Helen does not love Gwen, who loves Alan? —*Contributed*

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$5x^2 - 5bx + (b^2 + 2b + 5) = 0$. Thus $b = 5 + 8 = 13$ and the Martians had 13 fingers.

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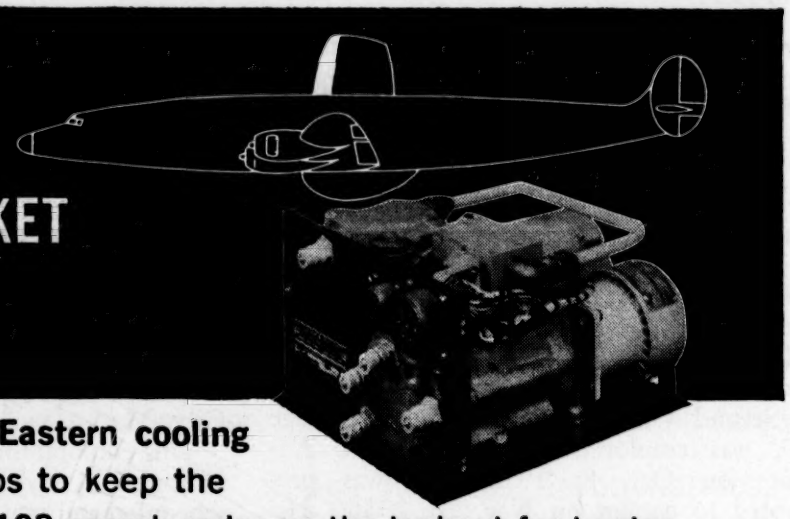

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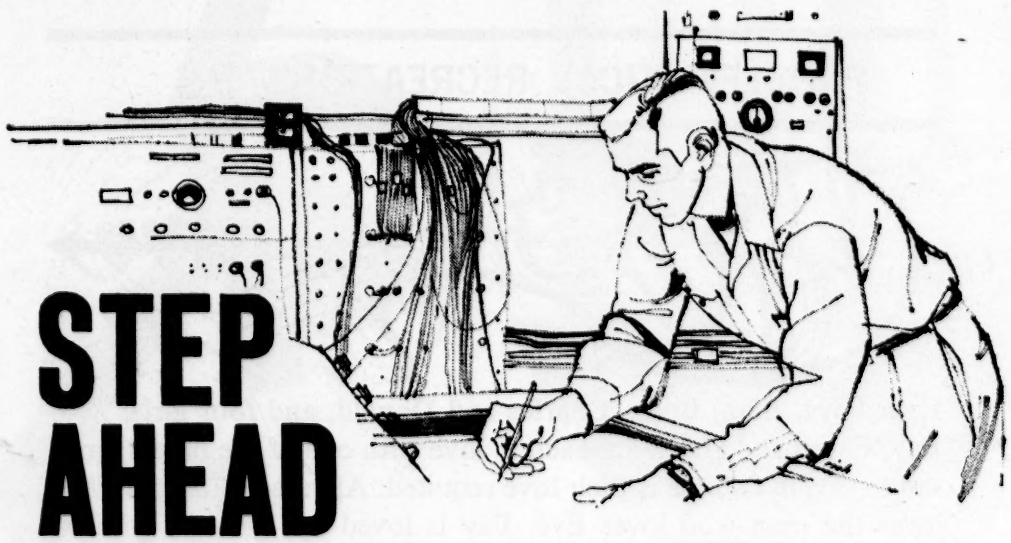

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WHO'S WHERE

(Continued from page 23)

Changes

Shillelagh Operations (formerly Tactical Systems Operations), Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif., has been split into two major segments and the following appointments have been made: **Louis F. Heilig,** assistant general operations manager for Engineering; **Arthur C. Haines,** assistant general operations manager for Program Management.

Peter Horton, director of plans, Missile and Space Systems Division, Douglas Aircraft Co., Inc., Santa Monica, Calif.

Eugene W. Kyle, systems sales manager, Burbank Branch, Librascope Division of General Precision, Inc., Glendale, Calif.

United Aircraft Corp.'s Norden Division, Norwalk, Conn., has formed a new Precision Components Department, and **William P. Huxley,** Norden's assistant general manager, has been appointed to direct operations. Also: **Shu Lee,** chief engineer; **Alfred P. Tis,** operations manager; **Kenneth A. Bacon,** sales manager.

Gordon L. Reese, market research manager, Kaynar Mfg. Co., Inc., Pico Rivera, Calif., and **John Wright, Jr.,** merchandising manager.

General Electric Co.'s Light Military Electronics Department, Utica, N. Y., has appointed the following managers: **Charles W. Piper,** MOD-3 Program; **Richard E. Scanlon,** Mistram Program; **Casimir A. Zielinski,** Skybolt Program.

Winston H. Sharp, formerly an engineering metallurgist at Pratt & Whitney Aircraft, now a metallurgical consultant, Hartford, Conn.

Arthur V. Norden, a founder of Seaboard World Airlines and now an aviation management consultant, has been named U.S. representative for Whitworth Gloster Aircraft, Ltd., of the Hawker Siddeley aviation group, London, England.

Dr. William T. Clary, director of systems research, Information Systems Department, North American Aviation's Space and Information Systems Division, Downey, Calif.

R. C. Stiff, senior division manager of the newly established Engineering Operations Division, Liquid Rocket Plant, Aerojet-General Corp., Sacramento, Calif. Divisions and managers of the new organization are: **A. L. Feldman,** Chief Project Engineer; **H. L. Coplen,** Chief Engineer; **L. F. Kohrs,** Space Propulsion (Azusa, Calif.); **W. D. Drinkwater,** Development Fabrications; **J. H. Madden,** Reliability. Senior departments and managers are: **R. Beichel,** Special Projects; **I. L. Odgers,** Nuclear Engines; **C. M. Beighley,** Research; **J. C. Moise,** Advanced Systems.

Donald R. Neilson, director of research and development and assistant secretary of Bonanza Air Lines.

Frank J. Lavelle, marketing manager, Sperry Microwave Electronics Co., Clearwater, Fla., a division of Sperry Rand Corp.

Guy A. dal Molin, manager of engineering, Eutectic Welding Alloys Corp., Flushing, N. Y., and **Gordon E. Cossaboom,** manager of product planning.

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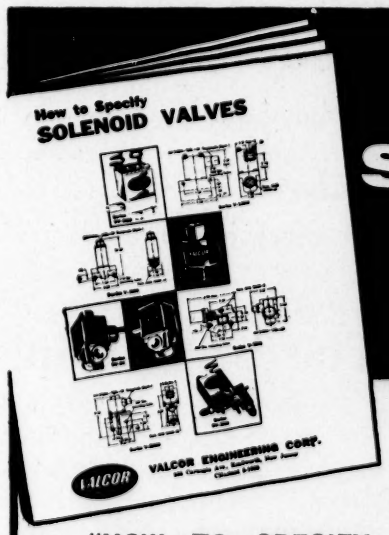

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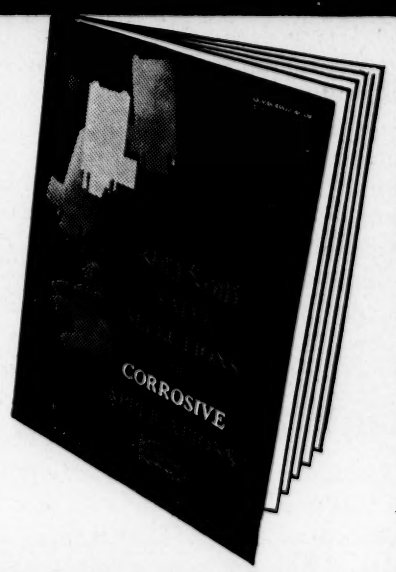

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LETTERS

Procurement Cost

Regarding the letter appearing in your magazine (AW Nov. 6, p. 120) concerning cost of procurement, I believe that Mr. Mela based on a few "facts" has overstated the situation. A basic error in the calculation is that he assumed a request for proposal for each of the 28 contracts, when in reality there was one request for each of the 14 study areas.

The Future Projects Office made an industrial survey, prior to releasing any requests for proposals, to find the companies who had the technical capabilities to assist in our study program. Based on this survey, bid lists were established for each study area and each company was notified of the proposal requests they would receive during the year.

Therefore, each company could decide on which studies they planned to bid.

A few statistics from the past year indicate that on these 14 study areas our office requested an average of nine proposals per study, and received about six bids on each.

Since there were, on the average, two contracts per study area, each company had about a one-in-three chance of being successful. Also, it should be pointed out that of the 14 study areas four have already been extended, and four more will be in the near future. Therefore, the "ruinous competition" as pointed out by Mr. Mela is not quite so bad.

This competition for the space dollar requires each company to maintain technical competence. This technical capability is achieved and maintained by either company-sponsored effort or by government-funded studies. In reality, the government is paying for effort industry must spend anyway to maintain their competitive position. This is proven by the fact that several companies, when not chosen as a contractor on a particular study, have elected to perform the study at company expense because of the expected value to themselves.

In view of the above, I believe Mr. Mela's argument was considerably overstated, however, I would be interested in reviewing "the many solutions which have been offered" since we are always looking for ways to improve the industry-government relationship.

H. H. KOELLE
Director, Future Projects Office
George C. Marshall Space Flight Center
Huntsville, Ala.

New Aviation Society

I would appreciate the publication of this letter in AVIATION WEEK to call attention to the formation of "The Roosevelt Field Aviation Alumni Association."

The RFAAA is an honorary society of airmen and others whose aviation background is linked to or associated with Roosevelt Field between the years of 1920 and June, 1951, when it ceased operations as an airport. There are no dues or fees of any kind, however, membership will be by invitation to all eligible.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

W. D. "Jim" Guthrie, who for many years was manager of Roosevelt Field, is the permanent president. He is most anxious to have anyone write him for a membership application, and upon acceptance by a committee which he has appointed, invitation for membership will go out.

The purpose of the RFAAA is to encourage a continuing fellowship among those who in any way, airborne or aground, contributed to the traditions, history and legends of this mecca of aviation men and women. Clubrooms have been arranged for in East Norwich, Long Island, and a formal inaugural dinner is planned for early next year. These rooms are those once used by the late President Theodore Roosevelt, father of Quentin, for whom the field was named. These rooms are to be known as "The Roosevelt Field Lounge" with special decorations supplied by some of the nation's top aviation enterprises, which at one time or the other were located on the field. These rooms are situated in Rothmann's East Norwich Inn, also one of aviation's most famed landmarks. It is expected that approximately 1,000 individuals will compose our membership, among which are most of the country's most celebrated aviation personalities.

N. A. DICK BROWN
Executive Secretary
Roosevelt Field Aviation Alumni Assn.
Room 2-C
227 7th Street
Garden City, N. Y.

The Unknowing

I wish to assure Mr. Denis Brasket (AW Nov. 6, p. 120) that the broad millions of German citizens had no knowledge of the atrocities committed in the concentration camps during the Nazi regime.

If it were not for the misfiring of a V-2 that finally fell down somewhere in Sweden in 1944, Germans neither would have learned about said weapon nor the development of which started in 1937 in the hermetically secluded area of Peenemunde.

Things like these, and others equally inhuman, go that way in police states governed by neurotic tyrants. Some research in very recent Russian history (1917-1939) will reveal to you that the number of six million was already exceeded at that time. These days one doesn't have to look very far, either!

So, Mr. Denis Brasket, let us be active, not passive about it. Let us jointly defend ourselves, our country and hemisphere against the subversion and final physical destruction of our very lives.

KARL L. SANDERS
Lawndale, Calif.

X-15 Program

Congratulations on your editorial in the Nov. 20 issue of AVIATION WEEK regarding the X-15. I couldn't agree with you more!

From the very first, this program has been conducted in a most orderly manner, with little fanfare and with a maximum of success. The organizers of this program deserve a great amount of credit.

As an old "glider guider," if it should be my lot to have to go out into space and attempt to return, I'd choose an extrapolation of the X-15 method.

A monkey is welcome to my seat in one of these Mercury capsules any time, and could probably perform the necessary functions equally well.

RALPH S. BARNABY
Past-President
The Early Birds
Philadelphia, Pa.

Misusing Universities

In regard to the article in the Oct. 30 issue of AVIATION WEEK (p. 21), regarding the NASA Education Plan, I have several pertinent comments.

Having been recently discharged from the Air Force, and having been in a position of overseeing a government contract with a university, I can understand why universities are reticent—in fact, steer away from close cooperation with the government, whether it be the Air Force, NASA, the Army, or what have you, with the exception of a very few agencies, such as the National Science Foundation. In general, it can be said that government cooperation in the form of contract work means, for a university, some form of experimental or consulting effort. Again, in general, this work involves efforts of an applied nature, in some instances merely items of routine or repetitive testing which, of course, are untaxing and unchallenging to the trained scientific mind. In many cases it serves to stagnate.

There are many cases in point of universities which devote themselves to such "hardware" work in order to maintain fellowships and assistantships for graduate students; the work performed cannot really be called research, but it may satisfy the requirements of these latter universities for M.S. or even Ph.D. dissertations. This seems to be a good way to lower the quality of college graduate programs in the science and engineering fields. There are ever-present "strings" attached to government contracts; this is why many good universities shy away. Well, you say, the work must be carried out by someone—who is it to be? To me, industry seems a much more logical choice for sound engineering work of an applied nature, but remove the encumbrances from the contracts awarded to universities and you will find a great deal of cooperation and output of valuable research of a higher, more sophisticated nature.

GEORGE MAYER
Allston, Mass.